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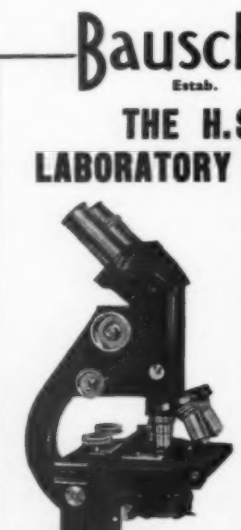

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Social Science Problems and Programme

WHEN the Council of the British Association meets next month, it will have before it the approval by the General Committee at the Cambridge meeting of the recommendation to create a new Division to deal with the social and international relations of science. So far, during the century or more of its existence, the work of the Association under the administration of the Council and subject to the approval of policy by the General Committee, has been carried on through the Sections, each dealing with a particular branch of science and meeting only once a year. As is implied by the deliberate choice of the term Division, the new organization is intended to operate on somewhat different lines, being intimately affiliated with the Association but semi-autonomous. Much preliminary work will be required before the precise form and activities of the Division can be determined; but the main object of the Division, to further the objective study of the social relations of science, offers ample scope for undertaking research, including factual studies on the organization of science and its social and economic relations, for discussion of the social aspect of science, the consideration of the public relations of science, and for consultative work or as a co-ordinating centre and information bureau.

The science of society is still embryonic, and though the British Association may well prove to have taken a decisive step in accelerating its development, even the main lines of organization or activity of the new Division will probably require some time to determine. Apart from anything else, the relative merits of various lines of work, such as the actual initiation of research on particular subjects, and the various possibilities in regard to consultative or co-ordinating work, as well as to the importance of implementing means for bringing the findings of science more effectively before the general public, must be determined before the new Division can well allocate its resources and activities. Nor can it be indifferent to such recent developments as the founding of Nuffield College, Oxford, and the recently established National Institute for Economic and Social Research, London.

The extent and character of the investigations provided by such bodies will obviously be a matter of prime concern to the new Division in considering the initiation of any research project of its own. In considering the initial activities of the Division, however, especially in regard to factual research, the plan adopted by the Committee on Science and its Social Relations (C.S.S.R.) of the International Council of Scientific Unions should be of some assistance. This Committee is endeavouring to collect material for the preparation of a report and of bibliographies on the social relations of science, to be presented at the next meeting of the International Council of Scientific Unions in 1940. The report is designed to cover outstanding developments in the various branches of science, new applications of science in human society, the organization of scientific investigation and its application, with summaries of interpretative work on the world picture as given by science and its social relations.

In pursuance of this plan, the Committee has approached national academies and a number of international scientific organizations for assistance by the supply of relevant information. A number of correspondents have in this way been appointed to whom have been forwarded a questionnaire

covering points in science in general and in special branches of science upon which information is required. These questionnaires should be of value in framing the initial policy of the new Division of the British Association. Obviously, as is implied in what has already been written, the Division should first have regard to the existing position of social research in Great Britain. It must have before it accurate information as to the extent and resources of the research effort in this field. Something of the nature of what may be termed a map of social research is called for at an early stage. To meet this requirement the Division might well decide to attempt to develop co-ordinating functions and activities and to establish a co-ordinating committee or information bureau, and also to establish relations with institutions dealing with social relations of science at home and abroad.

The required picture of research, however, cannot be limited to social research alone. Its significance can only be assessed when it is seen in its proper perspective in the general map of research effort, both scientific and industrial. For this reason, the Division might well consider implementing an inquiry into the nature, extent and resources available for scientific and technical research in Great Britain generally, on larger and more authoritative lines than the inquiry initiated some years ago by the Association of Scientific Workers.

Acquisition of precise data in this manner is undoubtedly an essential preliminary if the new Division is to utilize to the best advantage such resources as may be at its disposal for factual research in social sciences. Moreover, it can scarcely be doubted that apart from the researches actually initiated by the Division, its influence could most valuably be exerted to assist in such a reorientation or diversion of research effort from the physical to the biological sciences as has been urged by Prof. W. McDougall, Dr. Julian Huxley and others. Such representations would gain immensely in authority if supported by data drawn from such a survey as we have indicated.

The activities we have just suggested are of themselves likely to require the institution of effort or the establishment of organization to deal with many other matters contemplated in the memoranda submitted to the General Committee of the Association at Cambridge, such as the establishment of consultative machinery, the supply of material for the information of the public, and so on. Moreover, the appointment of research committees similar to those constituted by the various sections of the Association must be one of the functions of the Division.

The initiation of research by the new Division requires, however, not only a survey of existing activities and resources but also the elaboration of an adequate plan of research. It is not essential to assume that the Division should alone be responsible for the actual initiation of research. One of its valuable functions, if it develops into the co-ordinating institution that is desired, may well be that of providing an authoritative plan of research desirable in the social field, the execution of which in detail is carried out by consultation with the various research institutions as well as by research committees of the Division.

What may be termed the research programme of the new Division might thus consist of a broad and long-range plan conceived in relation to the needs and opportunities as revealed by the information available, which would form the basis of detailed programmes, some of which might be executed by the Division itself and others by other institutions or some of the professional associations whose contribution at present is insignificant. Possession of a broad and long-range plan would, moreover, enable the Division to take the detached view essential if its recommendations from time to time regarding the diversion and re-orientation of research effort are to carry due weight and authority.

An admirable exposition of possibilities for basic research in this field has been given by Prof. H. Levy in a chapter on the scientific study of social development in his recent book: "A Philosophy for a Modern Man". Indeed, many of the features of social life which he enumerates as requiring quantitative measures constitute a programme which might with advantage be considered by the Division. These variables fall into three main groups. There are first the qualities which determine the technological level of the community, within which group are included all types of business and industrial enterprise. Then there are the qualities defining the physiological level of the population. In this group are included all those factors that determine the conditions under which people live. The third group comprises the qualities which define the cultural level of the population and includes all those mental and æsthetic qualities that thrive or are frustrated by the conditions imposed in the other two fields.

Prof. Levy's approach is, indeed, very similar to that adopted by Lord Stamp in the programme of research outlined in his "Science and Social Adjustment" which also claims the attention of the new Division. Prof. Levy, indeed, reiterates in somewhat different form a number of Lord Stamp's proposals. He suggests, for example, the construction of an index of the degree of research activity in the community, and sub-indexes showing how this is composed of research in fields ranging from highly industrial and engineering to highly abstract, mathematical or logical. He suggests further a special index to measure the degree to which research is directed towards destructive ends rather than constructive progress.

Again, indexes are required to measure the general technical level of commodity production or the social waste in the distributive and productive processes, particularly in relation to the effect of intensive advertisement. Similarly, it should be possible to establish some standard of maximum social efficiency in shelter and housing provided for the community at any given time. This would imply a relative index of efficiency of housing and accommodation for various social classes. Like Lord Stamp, Prof. Levy directs attention to the need for a fundamental study of invention clearing in relation to patents and some index which would take account of factors hindering the assimilation or development of inventions. Technological unemployment is another topic presenting problems demanding quantitative study, while on the physiological side Prof. Levy urges the elaboration of an index of physical fitness applicable not only to individuals but also to social classes, as well as an environmental index, a food-value level based on the biological value of the food consumed by the individual, to be taken in association with the cost of living index figure, as well as a resistance index to measure the extent to which the individual can withstand the onset of various illnesses, diseases or epidemics.

Here alone indeed there is outlined a programme which the new Division might at first well find overwhelming. If, however, its organization and activities are conceived on broad, fundamental and long-range lines, there need be no fear of its being so immersed in the detail of a few investigations that it fails to exercise the co-ordinating and stimulating effect over the whole field that is desired. So far as specific researches may be concerned, its contribution, apart from the formulation of a broad plan, may well be in just those borderline problems, at the growing points of research in different departments of science which involve organized and many-sided efforts for their solution. While, therefore, the new Division may appoint research committees to report upon these and other matters, it will be desirable at an early stage to examine the data which must form the basis alike for a comprehensive plan of social research or for any representation designed either to re-orientate research effort or to stimulate fresh effort in professional or other quarters.

A History of Bacteriology and Bacteriologists

The History of Bacteriology
By Prof. William Bulloch. (University of London, Heath Clark Lectures, 1936, delivered at the London School of Hygiene and Tropical Medicine.) Pp. xii + 422 + 16 plates. (London, New York and Toronto: Oxford University Press, 1938.) 10*s.* 6*d.* net.

SINCE the appearance of Löffler's fragmentary and otherwise faulty "Lectures" in 1887, students of the history of bacteriology have had no guide-book to this intriguing and complicated subject. They will all, therefore, welcome the present volume—written by the foremost living authority, who has lived through the heroic age and was personally acquainted with many of the heroes. It is true he had given us a foretaste of his knowledge in the "System of Bacteriology" (vol. 1, 1930) published by the Medical Research Council: but this larva is now metamorphosed into an imago which will surely serve the most exacting needs of historical students for at least another generation. Though originally delivered—like Löffler's essay—in the form of lectures, this final product is actually a well-documented contribution to science.

The book is divided into eleven chapters dealing respectively with ancient doctrines of contagion;

contagium animatum ; fermentation ; spontaneous generation and heterogenesis ; putrefaction and putrid intoxication ; pyæmia, septicæmia, and surgical sepsis ; specific element in disease ; classification of bacteria ; cultivation of bacteria ; Pasteur's work on attenuation of virus ; history of doctrines of immunity. These chapters are amplified by copious and detailed individual bibliographies (64 pages), and a concise international biographical dictionary (58 pages) of "some of the early workers in bacteriology"—which is as remarkable for its inclusions as for its omissions. Sixteen inserted plates of portraits and other illustrative matter, with two full indexes of persons and subjects, round off the work.

No man, living or dead, has ever before attempted to cover all this ground with the same thoroughness. As the author says, in his short preface, if the task had been easy it would not have been left so long undone. Consequently, this book is incomparable in every sense ; and for this reason there is probably no man now alive who is competent to review or criticize it in its entirety. The following remarks therefore merely record the impressions which it has made upon another and less experienced labourer in neighbouring historic fields, who can make no claim to first-hand knowledge of all the sources and materials which are here so ably expounded and summarized.

My first impression—for what it may be worth, after a single perusal—is one of unqualified admiration for the author's solid learning. I was already aware, of course, that he had studied the subject all his life, and I have ever admired and respected his dogged devotion to facts : yet I now appreciate once more, as though they were something new, the sterling qualities displayed in this book. The data are presented concisely and fairly ; and the author's own comments and conclusions appear, to me, almost invariably just and judicious. A young man could not have composed such a book, and few older men could have compressed their ripe knowledge and experience into so small a compass. Yet there is here no parade of erudition : most of the real work was obviously done—as it should be—before the book was written. In other words, the recorded facts have been ascertained, verified, and properly digested, before presentation. Many a simple sentence in this treatise must have taken years to evolve.

With so much to choose from, it is difficult to notice any one section particularly ; but for my own part I find the chapter on spontaneous generation especially pleasing, as it reviews most satisfactorily and adequately almost the whole of this complex and previously misreported subject. The account of Pasteur's work—not only here but also elsewhere—is masterly.

In a work of this scope and size it is obviously impossible that no faults should be discoverable. The half-dozen typographical errors which I have noted should probably be laid to the charge of the printers (for example, 'lave' for 'have' (p. viii), 'pencillium' for '*Penicillium*' (p. 92), 'Wilinan' for 'Willnau' (p. 417), etc.). But a few other slips also require amendment. Those old familiar friends "the two Janssens" crop up again, regrettably, on p. 19. (Zacharias is properly styled Janssen because his father was named Johannes—*alias* Hans or Jan : but Johannes was not a 'Janssen', but Zachariassen, as Zacharias was his father. In this case Janssen was not a surname but a patronymic.) The statement, on the same page, that "the solar microscope invented by Leeuwenhoek was perfected by J. N. Lieberkühn in 1739" is incorrect : for Leeuwenhoek never invented a solar microscope, and the prevalent belief that he used a concave mirror-magnifier of the Lieberkühn type appears to be based merely upon a misunderstanding of his own words and pictures. It is also incorrect to say that O. F. Müller—the "great Danish naturalist", as he is rightly called—was "born of German parents" (p. 384). His father's family, it is true, were German immigrants into Denmark ; but his mother was a Dane (*née* Margrethe Henriette Udsen). The title of Le Leu's "Life" of that singular character Dr. David Gruby is not "*Le David Gruby*" (p. 370) but "*Le Dr. Gruby*". I have noted a few other mistakes of the same order of triviality, but can detect none of major magnitude in matters with which I am specially familiar.

Although it covers so vast a field, this 'history of bacteriology' is primarily a history of the medical aspects of the subject and of those engaged in it. Even on the medical side, moreover, there is a striking omission : those interesting and important organisms the spirochætes are barely mentioned. The history of iron-bacteria, sulphur-bacteria, nitrifying and other soil-bacteria of great physiological and economic importance is also almost excluded. Winogradsky (who was awarded the Leeuwenhoek Medal for his researches in 1935) is given three lines in the biographical section, but his work is practically ignored in the text. I regret to note also that the earliest English observers and illustrators of bacteria have likewise been strangely overlooked. Edmund King (1693), John Harris (1696), and the celebrated "Anonymous of 1703" were surely worthy of note. Robert Hooke is included, however, among the "early workers" in the biographical notices ; but his observations on bacteria are nowhere recorded. And it is a pity, I think, that quotations are not always given with the exact spelling, punctuation, and other typographical peculiarities of their

prototypes (see, for example, the citations from Leeuwenhoek and Benjamin Marten). To my mind, quotations—especially in a historical work—should always be given in their original form exactly. But these are clearly trifles in comparison with the immense mass of accurate facts and critically sifted data here impartially recorded and analysed.

This is manifestly an important book, but one which, as I have already indicated, I am not competent to judge—indeed, I should be the last man to judge or criticize it as a whole. All who are personally acquainted with its author, and who are truly interested in its theme, must simply rejoice to see these mature judgements and records preserved in print for all time. Some of us had previously been privileged to hear them—at least in part—more racily recounted by his own lips in his native Doric: yet even those who have not had this advantage must now recognize that this work is the outcome of a lifetime devoted to the pursuit of naked truth. Apparently nothing in it is given at second-hand: all its information is fearlessly and faithfully chronicled from original sources. It is scientific history in the best historical tradition—accurate, objective, and honest—and can therefore be copied with complete confidence. Consequently, I foresee a great popularity for this monograph among lesser writers of historical 'sections' and 'introductions' to all manner of future articles. Seldom can one buy such an almost miraculous haul of historical fish for half a guinea.

Nevertheless, this admirable book is not merely a paradise for poachers: it will also be used and trusted and acknowledged by every serious student who henceforth attempts to explore any of the same territory, and will undoubtedly remain an everlasting inspiration to all future workers. Incidentally, and appropriately, it illustrates anew the truth in a saying of Leeuwenhoek (the first genuine bacteriologist, as he is here justly acclaimed) that *"de vrugten, die in den herfst rijp werden, langst konnen duuren"*—those fruits which ripen in autumn can last the longest.

CLIFFORD DOBELL.

British Mosquitoes

The British Mosquitoes
By J. F. Marshall. Pp. xi + 341 + 20 plates. (London: British Museum (Natural History), 1938.) 20*s*.

IN 1920, the British Museum published a "Handbook of British Mosquitoes" by Dr. W. D. Lang; it set up a new standard in its figures, attention to early stages and in other ways. That book has now been replaced by Mr. Marshall's, which, though it owes much to its forerunner, is definitely a new book and in many ways an advance on extant works on mosquitoes. It is a matter of some interest to notice that both these books have been written by men who might claim the distinction of being amateurs. The author of the first, a palæontologist, was asked under the stress of war to produce a monograph on these insects. The author of the second, an engineer who found that salt marsh mosquitoes were uncomfortable neighbours, turned his mind first to control and, through that, to scientific study.

In 1920, the British list of mosquitoes included twenty species: the present work includes twenty-nine. About half these additions are due to more careful collecting, the remainder to the recognition of species previously undetected or not regarded as separate.

The general structure of the book is on accepted lines. Mr. Marshall tells the reader how to recognize a mosquito and introduces him to classification and nomenclature. One may feel perhaps that, though this is well done, it is scarcely necessary, for it has been done so often before, and a reader quite ignorant of mosquitoes is not likely to use this serious work as a primer. The general account of the biology of British mosquitoes at all stages includes an ingenious calendar showing what stage of each species may be found month by month. For some of the species, this has been elaborated to show the seasonal occurrence of each of the four larval stages separately. One may here remark on the ingenuity with which the author sets out information as tables and diagrams. The account of the early stages of adults of British mosquitoes deals particularly with those anatomical points which are used in classification, and the information is so full that one may separate the four larval stages of almost all the species. There is no other part of the world for which this detailed information is at present available.

Leaving general topics, Mr. Marshall then gives a review of the British Anophelines and Culicines. In each of the descriptions, attention is first directed to the chief distinguishing features of the adult, the hypopygium and the larva. In some cases a description of the pupa or of the egg has been included in addition. This morphological information is followed by a short account of the

life-history, ecology, etc., of the species concerned, and also (in most cases) by a list of its British records. The description of each species concludes with a brief summary of its foreign distribution. This part of the work is fully and beautifully illustrated, the majority of the text figures being by Terzi. An account of methods of control and some general notes on biology bring the book to an end.

It need scarcely be said that different authors would emphasize rather different parts of the subject. The present reviewer thinks that the account of those races of *Anopheles maculipennis* which do not occur in Britain might well have been omitted, particularly as the subject has received such full attention elsewhere. It seems also that some reference should have been made to the British record of the yellow fever mosquito (*Aedes argenteus*). No one supposes that the insect occurs wild in Britain; but there is a printed record of it being found in Epping Forest which should perhaps have been mentioned, if only to point out that it might have been based on an error.

The book as a whole is remarkably up to date, even on matters about which many entomologists are not well informed, such as the relation of species of *Anopheles* to malaria and the physiology of mosquitoes. The great majority of the figures are line drawings by Mr. Terzi, many of them having already appeared in the previous book. There are also some remarkably successful photographs of adult mosquitoes taken by the author and his assistant, Mr. Staley. The few coloured plates are perhaps unnecessary, and not particularly successful.

P. A. BUXTON.

Relative Abilities in Primitive Groups

Primitive Intelligence and Environment
By Dr. S. D. Porteus. Pp. ix+325. (New York: The Macmillan Co., 1937.) 15s. net.

DR. S. D. PORTEUS has an honourable record of studies in the comparative psychological endowment and capacities common in different social groups. It is, therefore, the more to be regretted that this particular book is rather hastily thrown together, and falls far short of what should reasonably be required in any scientific treatise. Two thirds of it consists in theoretical discussion and in interesting, but superficial, descriptions of the social and material environment of the various groups the members of which Dr. Porteus has directly studied.

In the theoretical discussion the author shows himself to be alive to the difficulties of the type of comparisons which he is attempting to make, and he states those difficulties fairly and well. But that small portion of the book which is devoted to facts is poor. The evidence brought forward is not impressive in amount, the methods employed —all consisting in the application of mental and physical 'tests'—are not adequately described, and the statistical form in which the results of the tests are presented is thoroughly unsatisfactory. Very nearly half this factual section is devoted to a study of results secured from some form or forms of the author's well-known 'maze test', here treated, without anything like sufficient justification, as an index of capability to adapt to the demands of an encroaching white civilization. If the test can be treated in this way, it is certainly a most extraordinary thing to find that various groups of Australian aboriginals score more highly at it than do groups of Bantu natives. But as only average scores are presented, with no measure whatsoever of dispersion, and no indication of the distribution of scores, it is actually impossible to draw any sure conclusion.

Other comparisons are made on the basis of psychophysical factors: brain capacity, right- and left-hand grip, and right- or left-hand dominance of grip. Apart from the fact that here, also, only average measures are presented, nobody knows yet what conclusions, if any, of a psychological nature can be drawn from these particular characteristics.

Finally, there is a short chapter on "Tests of Learning Capacity". These are, in this book, rather a mixed grill. They are made up of form board and assembling tests, a footprints test—in which duplicate photographs of footprints on a dusty road have to be matched with the originals —tests of auditory and visual rote memory, and a small battery of 'intelligence' tests of the routine kind. From the application of these, little is concluded.

Dr. Porteus says that he will present the whole of the statistical detail later and fully. Until he does so, a final judgment of the value of his work as recorded in this volume must be suspended. When he does so, it is greatly to be hoped that he will consider fully what precise criteria, both of a statistical and of a general psychological kind, must be satisfied if the results of the application of psychological tests are to be used seriously for the purpose of comparing the relative abilities common in differently organized groups.

F. C. B.

The Reverse Notation:
Introducing Negative Digits with Twelve as Base. By J. Halcro-Johnston. Pp. x+74. (Glasgow and London: Blackie and Son, Ltd., 1938.) 3*s*. 6*d*. net.

IN this interesting book, the author explains a new notation which he has devised to remove the main defects of the Arabic notation. The two main characteristics of the system, called the reverse notation, are the introduction of negative digits and the adoption of 12 as the radix or base. The consecutive sequence of digits is written: $\bar{6}$, $\bar{5}$, $\bar{4}$, $\bar{3}$, $\bar{2}$, $\bar{1}$, 0, 1, 2, 3, 4, 5, 6, so that any number like 8 is denoted by $1\bar{4}$, whilst $1\bar{5}4$ represents seven dozen and four. The notation is applied to the ordinary rules of arithmetic and the author claims that the numbers of the reverse notation "are balanced about their *centres of gravity*", which is not the case with the Arabic system.

The whole scheme is undoubtedly very ingenious, but when judged impartially, there appear to be far more difficulties in the notation than there are disadvantages in the existing Arabic system. The initial trouble that teachers have in introducing and working with negative characteristics in logarithms is well known. Indeed, to arouse a true concept of a negative number is by no means an easy problem either in psychology or pedagogy. Yet in the system before us, negative digits abound; for example, $\log 3 = 0{\cdot}5\bar{4}\bar{4}0$, $\log 6{\cdot}3\bar{3}5 = \bar{1}{\cdot}3204$, $\pi = 3{\cdot}2\bar{4}5\bar{4}$ and on page 47, the number of days in the year is represented as $265{\cdot}3\bar{1}\bar{1}\bar{6}3$!

The author fully realizes that the introduction of such a notation is far from being a practical proposition, but hopes that it will be judged by the principle of the survival of the fittest. It is, nevertheless, very difficult to see how the system can first be introduced. Are accountants, scientific and technical computors, business men, etc., expected to incur the expense of changing the basic notation upon which they have made their calculations for so long? If they were sufficiently convinced of the advantages of the system to try the experiment, would this ultimately lead to the introduction of the notation into schools, where it should logically begin to evolve? One wonders, however, in this eventuality, what the teachers of arithmetic, especially in primary schools, would say to such a suggestion. F. G. W. B.

The Macaulay Institute for Soil Research
Collected Papers, Vol. 1. Edited by Dr. W. G. Ogg. Pp. 16+54 papers. (Aberdeen: Macaulay Institute for Soil Research, 1938.) 21*s*.

THE Macaulay Institute for Soil Research was founded for the purpose of studying possibilities of land reclamation on the Island of Lewis, and of raising the standard of agriculture and living of its inhabitants. Sir Robert Greig states in the preface that, since the foundation of the Institute, which is in Aberdeen, and of its experimental farm near Stornoway, Lewis has become more than self-supporting in milk and eggs, and fine pastures have appeared and are extending over the formerly worthless peat bogs. The Institute has justified its existence, and has tended inevitably to extend its research activities beyond its original field of peat-land reclamation.

These fifty-four reprints of papers by members of the staff indicate the steady growth in the scope of the Institute's work. The Macaulay Institute is the only British station devoted entirely to soil research. From peat studies it has branched out into the chemistry and physics of mineral soils, and latterly into soil classification and survey. One can trace in these papers the gradual evolution of a still incompletely formed "Macaulay" school of thought in soil science in which modern Russian and ancient Scottish beliefs are struggling for mastery. The papers themselves naturally vary in quality; some have obviously been included in order to make the collection complete rather than for their intrinsic value; but, omitting these, a high standard is maintained. It is noteworthy that most of the recently published papers deal with soil chemistry, classification and survey, rather than peat-land reclamation. This indicates a welcome development. Should Britain ever decide to take stock of its land, the Macaulay Institute would have an important part to play in the stock-taking. This collection of papers shows that it is already equipped for the part and can play it without detriment to the original purpose for which the Institute was founded.

Pyrenean Festivals:
Calendar Customs, Music and Magic, Drama and Dance. By Violet Alford. Pp. x+286+16 plates. (London: Chatto and Windus, 1937.) 15*s*. net.

MISS ALFORD is well known as a student of the folk-dance and song of European peasantry, but the Pyrenees is a region which in this subject she has made peculiarly her own province. In this volume, æsthetically delightful, as well as scientifically valuable, she has reviewed the results of some years of observation on both sides of the political frontier among the inhabitants of the Pyrenean regions from Catalonia on the east to the Basque country in the west. Nor has she confined her studies to dance and song, for she deals here with some remarkable forms of custom and magical belief which serve to throw light on the main theme.

The ethnological character of the peoples, as well as the geographical conditions of their habitat, have made for an intense conservatism in the past, which undoubtedly has led to the preservation in the dances of religious and cultural concepts, which in their origin are probably older than anything found elsewhere at present in Europe. Such, for example, is the remarkable cult of the bear; while an apparent transformation into animal form represented in the dance recalls the fact that it is in this country that there occurs the palæolithic painting of the animal-magician in the cave of Trois Frères of Ariège.

Miss Alford's work is a veritable gold mine for evidence of survivals of primitive modes of thought, and as such needs no further commendation to students of folk-lore and primitive religion.

Diffusion und chemische Reaktion in festen Stoffen
Von Prof. Dr. Wilhelm Jost. (Die chemische Reaktion, herausgegeben von K. F. Bonhoeffer und H. Mark, Band 2.) Pp. viii+231. (Dresden und Leipzig: Theodor Steinkopff, 1937.) 20 gold marks.

THE present book deals with a number of phenomena which are of importance in modern physical chemistry. The chapters deal with diffusion processes in the solid state, irregularities in lattices (*Fehlordnung*), the elementary processes in solid reactions, tarnish, and general reactions in the solid state. Although the literature is fairly well covered, there is more emphasis on modern work, including English and American. The field covered is limited, so that many topics such as recrystallization are excluded, but those parts selected for treatment are chosen judiciously and are dealt with in a very critical and systematic way. A good feature is the close relation which is established between the theoretical principles (which are very clearly stated) and the experimental results. The book is a well presented and accurate survey of an interesting subject.

Reagent Chemicals and Standards:
with Methods of Assaying and Testing them; also the Preparation and Standardization of Volumetric Solutions and Extensive Tables of Equivalents. By Joseph Rosin. Pp. x + 530. (London: Chapman and Hall, Ltd., 1937.) 30*s*. net.

THERE are comparatively few books which deal with the standards and specifications for chemical reagents and, if only for this reason, the treatise under review would be acceptable; it is, however, doubly welcome in that it provides the most complete treatment of the subject hitherto produced. Nearly five hundred substances are listed, these including many of the newer organic chemicals and indicators. Assays are provided in most cases for the major constituent as well as for the likely impurities, while tables are given of the maximum tolerance permitted for the latter. There is also a useful section on the preparation and standardization of volumetric solutions, together with extensive tables of equivalents and gravimetric factors.

A Note-Book of Tropical Agriculture
Compiled by Prof. R. Cecil Wood. Second edition. Pp. iv+147. (Trinidad: Imperial College of Tropical Agriculture, 1937.) 5*s*.

THIS is a small book that can be wholeheartedly recommended. It is a development of a small compilation which the author made while he was in India, and now he has added the results of his experience in Africa and in the West Indies. Of course, many of the data given have no special reference to the tropics, but the really valuable part of the book is that dealing with tropical materials and especially with tropical crops, about which it is somewhat difficult to get information. The book cannot fail to be of value to all who are proceeding to positions connected with agriculture in any part of the tropics. H. H. M.

Florae Siamensis Enumeratio:
a List of the Plants known from Siam, with Records of their Occurrence. By the late Prof. W. G. Craib. Edited by A. F. G. Kerr. Vol. 2, Part 4: Vaccinieæ to Styraceæ. Pp. 311–393. (Bangkok: The Bangkok Times Press, Ltd.; London: Luzac and Co., 1938.) 7 tcs.; 12*s*. 10*d*.

STUDENTS of Asiatic botany will welcome the appearance of Vol. 2, Part 4, of this work. The "Enumeratio" was commenced in 1925 by the late Prof. G. W. Craib, and since his death Dr. A. F. G. Kerr has carried on the work.

The present volume, which is arranged on the Bentham and Hooker system, contains the families Vaccinieæ to Styraceæ. A glance at the names of the collectors and of the authors of new species shows how greatly we are indebted to Prof. Craib, Dr. Kerr and their co-workers for our knowledge of the flora of Siam. The issue of further parts will be awaited with interest.

Nationalism and the Communal Mind
By Dr. E. Hanbury Hankin. Pp. xv+199. (London: Watts and Co., Ltd., 1937.) 7*s*. 6*d*. net.

DR. HANKIN'S approach to the problem of nationalism, and his examination of the causes which underlie the sporadic and periodic outbursts of this expression of the communal mind, are of considerable interest to the anthropologist and the alienist. Like other inquirers, he traces it to the blood bond, but in a different sense. He associates it with the group of customs of primitive peoples at the head of which are cannibalism, head-hunting and the like, and behind which are the magical or mystical conceptions of assimilation of power, whether from enemy or friend. In support of the contention that primitive ideas of this type may survive deep down in the subconscious of the communal mind, the sporadic resurgence of cannibalism and other forms of the blood lust would appear to lend a measure of support.

Die Leuchtmassen und ihre Verwendung:
eine Einführung in Fluoreszenz und Phosphoreszenz der festen Körper. Von Dr. Henriette Rupp. Pp. vi+163+2 plates. (Berlin: Gebrüder Borntraeger, 1937.) 8 gold marks.

PHOSPHORESCENCE has so many modern applications and is of such fundamental significance in connexion with the theory of the solid state, that the appearance of this well-written and comprehensive account of it is very welcome. Dr. Rupp describes the methods used to excite and analyse phosphorescent light, and gives an outline of the principal uses of phosphorescent bodies and the theories of phosphorescence. Her book is particularly valuable from the orderly way in which phenomena are classified, permitting of quick reference to any particular aspect of the subject, and for the detailed accounts provided of the preparation of some materials of technical importance. It includes a short history of phosphorescence, and a bibliography of recent publications.

Oceanography and the Fluctuations in the Abundance of Marine Animals*

By Dr. Stanley Kemp, F.R.S.

A MOST important feature of animal life in the sea is the constant occurrence of large variations in abundance, and these, though they may not be greater, appear to be more general in their incidence than in land animals. One year may be exceptionally favourable, with production far above normal, to be followed perhaps by several years of scarcity; and it is not uncommon to find that fish belonging to one year-class are fifty times as numerous as those of another. It is on these great variations in abundance that fishery prediction is based.

Some very valuable information on fluctuations in year-classes of fish has recently been collected by the International Council for the Exploration of the Sea. The object of the Council was to summarize data on good and bad survival years in some of the principal food fishes, and the reports from the specialists who were appointed to undertake the work are of particular interest. For some fish the available information was found insufficient; but for cod, haddock, herring and plaice the data are adequate, at least for some areas. The results show that in different parts of the north-east Atlantic there are with rare exceptions no coincidences in good or bad spawning seasons, even if one species only is considered, and the evidence thus is that the fluctuations which are observed are regional in their incidence.

Of recent years, however, it has become increasingly apparent that in addition to the annual fluctuations, there are other over-riding influences at work, which not only affect the abundance of marine animals, but also may bring about great changes in their distribution. For the past thirteen years, Mr. F. S. Russell has been studying the young fish taken in the plankton at Plymouth and has made regular collections by standard methods in the neighbourhood of the Eddystone. He finds that from 1931 onwards there has been an alarming decrease in the abundance of larval fish. At first this decrease occurred in the comparatively small number of summer spawning fish; but it has now extended to the spring spawning fish also. If we compare the average numbers for the four-year period 1934–37, with those for the same period ten years ago, 1924–27, we find that the larvæ of summer spawning fish have now been reduced to little more than one fifth of their former abundance, while the numbers of the young of spring spawning fish have dropped to one third. It is particularly to be noted that all species of fish are similarly affected, and bearing in mind the evidence I have already mentioned on good and bad survival years, this fact alone is sufficient to show that the decrease is not due to a chance coincidence in annual fluctuations.

This change which has come about in recent years is unfortunately apparent also in the Plymouth herring fishery, which has declined to such an extent that it is now virtually non-existent. As with herring fisheries elsewhere, the catch has shown marked fluctuations—the seasons 1924–25, 1927–28 and 1929–30 were much above the average. These, however, are normal annual fluctuations and they are due, as Mr. Ford has shown, to the great abundance of five-year old fish: there were specially successful spawning seasons in 1920, 1923 and 1925.

The significant feature is, however, the marked change in the composition of the catch which began in 1931–32—that is to say, in the winter of the year in which the summer spawning fish larvæ showed their first signs of decline. Prior to 1931–32, the younger herring, not more than six years old, always formed at least two thirds of the catch. In that season the younger fish were only 52 per cent of the total, and from then on there has been a rapid deterioration, until to-day there are less than 20 per cent of the younger and more than 80 per cent of the older.

The change found by Mr. Ford in the constitution of the herring shoals was not immediately reflected in the size of the catches, which for some years were maintained at a good level by the considerable stocks of older fish. But as these passed out, they were not replaced by any adequate numbers of the younger year classes, and in recent years the fishery has been profoundly affected. Formerly the number of Lowestoft drifters which visited Plymouth for the herring season rarely fell below 75 and was sometimes well over 100; during the past season only one came.

*From the presidential address to Section D (Zoology) of the British Association, delivered at Cambridge on August 18. The complete address contains several tables of data upon which the argument is based.

It is interesting and perhaps significant to note that, as Mr. G. P. Farran has shown, the stock of herring on the north coast of Donegal has shown a pronounced decline in recent years. The decline began in 1930, some eighteen months before the change in the constitution of the Plymouth shoals was first seen, and the industry based on this fishery has suffered greatly. Mr. Farran tells me, however, that the shortage of herring in recent years has been accompanied, just as at Plymouth, by a great reduction in the numbers of the earlier year classes, and it is thus possible that the same long-period fluctuation is affecting both areas.

Factors in Long-Period Fluctuations

Since 1931, when the depression in the Plymouth area began, there has been a marked change in the amount of phosphate in the offshore waters. Records made by Dr. W. R. G. Atkins and Dr. L. H. N. Cooper show that the phosphate is at its maximum in the winter, in December and January, and since the phytoplankton crop is limited by the amount of phosphate in the water, the winter records give a good indication of the quantity of food which will be available for fish larvæ. The records show a heavy decrease in phosphate beginning in 1931. If the average values for the two four-year periods 1924–27 and 1934–37 are compared, we find that the decrease has been about 35 per cent. The fact that the larvæ of summer spawning fish were the first to feel the adverse conditions, and that those of the spring spawning fish were not seriously affected until 1935, can in theory at least be explained in terms of nutrient salts; a reduced crop of phytoplankton will mean a smaller supply of zooplankton, and this will mostly be consumed by the spring larvæ, leaving little or none for those that come later in the year.

Renewal of the phosphate in the Channel appears to be largely dependent on an inflow of mixed Atlantic water, which is rich in phosphate because it contains water that has upwelled at the edge of the continental shelf; and it seems probable that the normal water movements off the mouth of the Channel have undergone marked alteration in recent years. Direct proof of this is lacking, for we have no observations in the waters to the west of the Channel, but evidence of it is afforded by the very interesting discovery which Mr. Russell has made that certain planktonic species may be used as indicators of water-masses. A relation of this kind has been found in a number of plankton species, but it is here only necessary to refer to those belonging to the genus *Sagitta*, and these owing to their abundance are the most useful.

Of the species of *Sagitta*, *S. serratodentata* is typical of the open Atlantic, *S. elegans* of the mixed Atlantic water and *S. setosa* of the Channel water. The first of these is only to be found on rare occasions off Plymouth when the inflow of Atlantic water is exceptional. Mr. Russell's data only began in 1930, and the records are therefore not as complete as could be desired. It is, however, known that for some years prior to this date the offshore plankton in the neighbourhood of Plymouth was of the kind characteristic of the mixed Atlantic water: it was a very rich plankton with such forms as *Meganyctiphanes* and *Aglantha*. It was this type of plankton which was found in 1930, and in the regular series of tow-net hauls made in that year, Mr. Russell found that there was 94 per cent of *S. elegans* and only 6 per cent of *S. setosa*. In the following year, when the deficiency of phosphate and of summer spawning fish larvæ first became manifest, there was a conspicuous change in the *Sagitta* population: of *S. elegans* there was only 17 per cent, while there was 83 per cent of *S. setosa*. Since then *S. setosa* has always greatly preponderated in the catches, with a percentage of 93 or more, with the single exception of 1936, when there was 60 per cent of *S. setosa* and 40 per cent of *S. elegans*. There is no doubt there was a small incursion of mixed Atlantic water in the Channel in this year, but it was apparently insufficient to alter the trend of events.

We thus have evidence from four separate sources of the changed conditions which have prevailed in the Channel since 1930–31. These sources are (i) the winter phosphate maximum; (ii) the numbers of fish larvæ; (iii) the constitution of the spawning herring shoals; and (iv) the predominance of one or other species of *Sagitta*. The picture, to my mind at least, is convincing: one gains the impression that if only we had fuller knowledge, corroborative data from many biological sources would be forthcoming.

We may suppose that this long-period fluctuation at the mouth of the Channel will end in due course, but we have no means of knowing when this will happen. When the change comes it will be heralded, we believe, by the return of *Sagitta elegans* in large numbers, and by a marked increase in the winter phosphate maximum. The fisherman will presumably not find any immediate improvement in the bottom fish. As yet he has perhaps scarcely realized the full extent of the depression which started some years ago, and when there is a return to better conditions, he must wait until the increased numbers of larvæ grow to fish of marketable size. It is possible, however, that bottom-living fish have been migrating into the area and that he may thus in some measure escape the worst

effects of the depression. If the younger herring have forsaken their spawning grounds and gone elsewhere, we may hope that they will at once return in force when conditions improve, and that the Plymouth fishery will rapidly be re-established. If, however, they have throughout held to their former migration routes, and the present dearth is due to lack of suitable conditions for the larvæ, they are in the same position as the bottom fish, and a number of years must elapse before the fishery can be resumed.

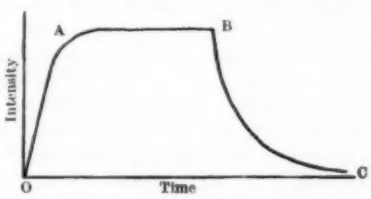
(To be continued.)

Luminescence

AN important series of discussions arranged by the Faraday Society took place in the Biochemical Theatre of the University of Oxford on September 15–17 on the subject of "Luminescence". A more appropriate time for the discussion of work in this field could scarcely have been chosen, and in spite of recent events, a surprisingly large number of visitors from overseas was present. The discussions were formally divided into three parts: luminescence of vapours, liquids, and solutions; luminescence of solids; chemiluminescence. The subject of luminescence is of particular interest at the present time for two reasons. First, it forms an excellent testing ground for some of the more recent theories, particularly with respect to the physical properties of solids, and the nature of chemical reactions. Secondly, a good deal of stimulation has been given by the technical interest in the subject. The use of fluorescent solids in discharge tubes as a means of modifying the colour of the light or increasing the efficiency of such devices is undoubtedly leading up to new work of interest, and contributions to the meeting were made by more than half a dozen industrial laboratories.

The first two parts of the discussion dealt essentially with the absorption of radiation by matter and its emission in the form of light; the final section was concerned, however, with the radiations emitted as a result of chemical reactions. The now classical experiments of Polanyi and his collaborators on the characteristics of the reaction between streams of halogen and sodium vapour at low pressure are a specially interesting example of chemiluminescence, in that they are providing the basis for theoretical work in this field.

A valuable feature of the earlier parts of the meeting was the way in which ideas concerning the precise meaning of the terms 'fluorescence' and 'phosphorescence' were brought out. If a luminescent compound is first illuminated at *O* (see accompanying graph) with radiation of constant intensity, an appreciable time may elapse before the luminescence reaches a constant value, as along *AB*. If the exciting radiation (for example, ultraviolet) is removed at a time corresponding to *B*, a rapidly falling curve of intensity *BC* follows. Many, and in fact most, of those engaged in experimental work in this field have usually referred to the part *AB* as 'fluorescence' and the part *BC* as 'phosphorescence'. This usage is undoubtedly convenient from the experimenter's point of view, since the time constant of the luminescence has usually been measured during the period *BC*. It has of course been realized that the electrons returning to the ground-state during the equilibrium period *AB* do so only after a finite and possibly considerable time after the absorption process. It was suggested in the course of the discussion that definitions based on the type of electron transition would be more fundamental than those already described. On this basis the term 'fluorescence'



should be reserved for all processes in which electrons are returning from *excited* energy states of parent atoms, and the term 'phosphorescence' used only in those cases where the luminescence is dependent on temperature, and is a result of electrons being involved in metastable states or completely removed from the parent atoms. It is likely that the older definitions will continue to be used on account of their convenience, and because of insufficient data concerning processes. Further progress along these lines can only be made by a study of the time-dependent effects of luminescence, and the corresponding photo-conductivity properties.

Very many substances, both liquid and solid, are capable of absorbing some part of the ultraviolet spectrum, but comparatively few are luminescent. It is to be assumed that the

non-luminescent substances convert this absorbed energy into heat in the form of elastic vibrations of much smaller quanta than visible light, and the important theory of Peierls developed some years ago on the problem of radiationless transitions in solids is now receiving much attention. This problem of radiationless transitions is of obvious importance to all branches of the subject. In liquids and solutions, for example, the fluorescence may be 'quenched' by increasing concentration of the luminescent centres, or by the addition of oxygen. The problems associated with the quenching of luminescence by a close coupling between the excited molecules and the surrounding solvent on one hand, and the question of internal quenching on the other, were made clearer by pictorial representation in intersecting curves of potential energy as a function of atomic or molecular separation. The work on liquids is concerned chiefly with organic solutions, and the complexity of the problem involved is shown by the fact that some organic solids show a large drop in the quantum efficiency of fluorescence when put into solution, while others show an equally sharp rise.

Almost a whole day was given up to the discussion of luminescence in solids, and on the whole this was the most successful feature of the meeting. It is now clearly recognized that there are two chief classes of luminescent solids. The more restricted class contains pure solids, and it is sometimes possible to recognize these by the fluorescence of their solutions; notable examples of this kind are the uranyl salts, the platinocyanides, and certain rare earth compounds. The fluorescence in the first two examples appears to be associated with co-ordination groups; in the rare earths the sharp line spectra are connected with transitions within the $4f$ shell, but it has not been explained why only certain of the rare earths are fluorescent.

Most luminescent solids, however, owe their properties to the deliberate addition of some impurity. But between the two well-defined groups of pure and deliberately impure solids are a number of others, the cause of luminescence in which is still in some doubt. Zinc oxide, for example, fluoresces in the near ultra-violet with an easily recognizable spectrum, and while it is assumed that the luminescence is linked up with the 'self' impurity of excess zinc, no direct proof of this has yet been obtained. The presence of *foreign* metal atoms in a solid may be made a matter of direct spectroscopic or chemical test, but other means will have to be adopted in cases such as that of zinc oxide. Calcium tungstate is also fluorescent when free from other metallic impurities, and it has been suggested that the WO_4 co-ordination group is of fundamental importance to the luminescence; it may well be, however, that the excess or defect of one of the lattice constituents has a bearing on this problem also. 'Pure' zinc sulphide presents a problem of even greater difficulty. Zinc sulphide has been prepared by several workers during the last few years in a state apparently free from foreign metallic impurity, and the fluorescence is a bright blue. The precipitation of zinc sulphide free from oxide is, however, a matter of great difficulty, if not impossible, and experiments have yet to be carried out to prove whether the luminescence is a property of the pure ZnS lattice or of a lattice containing (*a*) excess zinc or (*b*) some oxygen replacing sulphur atoms. These points have been mentioned merely to indicate that the problems of interpreting the luminescence of solids are by no means confined to the theoretical side.

The discussions at Oxford showed also the importance of low temperatures in the investigation of luminescence in solids. The spectra are, apart from a few exceptions, generally of a continuous nature at room temperature. The use of temperatures in the neighbourhood of 90°–20° K. has shown that many new features may be brought out, either in resolution, or in the comparison of various substances with a common activator. In quite a number of solids, luminescence is apparent only at these low temperatures. The difficulties of measuring the absorption spectra of solids in powder form are well known, but the discussion brought to light a new technique that will doubtless be of value in this field. Single crystals will, when obtainable, be of value, but the distinction between surface and volume luminescence was emphasized as a point of importance.

The theoretical aspects of this part of the discussion were of value in making clear the advance in ideas from the rather restricted zone theory as applied to semi-conductors a few years ago. On this theory the sharp energy levels of an isolated atom were converted in the solid to a series of possible energy bands, separated by 'forbidden' regions. In a pure insulating solid, it might be possible to raise an electron from the highest full band to the next possible empty band. When this happened, the electron would be free to move through the crystal under an applied field; such a case would correspond to the ionization of the parent atom, and the recombination of the electron with its positive 'hole' would give rise to the emission of radiation. The advance in theory is concerned with a possible series of excitation levels lying between the highest full band and the lowest conduction band. The 'forbidden' zone on these ideas no longer exists in simple form, and it is possible, as might be expected, to excite electrons in solids without making them free for photoconduction. An important feature of the newer

theoretical ideas is that it should be possible to distinguish between excited and ionized atoms in the solid by tests on photo-conduction and on phosphorescence. In the simplest cases the phosphors with a hyperbolic decay law should be photo-conducting, while those with exponential decay laws should not. The well-known high efficiency of alpha-particle excitation of luminescence in zinc sulphide phosphors, it was pointed out, is not due to the absorption of energy by the whole lattice and its subsequent transfer to the activating impurity atoms, but to the production of numbers of fairly high-energy electrons (δ-rays) colliding directly with the impurities.

The last part of the meeting was occupied with chemiluminescence, which is usually concerned with the production of light during chemical reactions; more recently, it has been shown that some reactions produce feeble radiations in the far ultra-violet. Bioluminescence is now generally regarded as a chemiluminescence in which the luciferin is oxidized in the presence of molecular oxygen and the enzyme luciferase. The work of Polanyi and Evans on sodium and chlorine vapour reactions is typical of one type of chemiluminescence and indicates that the production of light is a consequence of the following steps:

$$\begin{aligned} Na + X_2 &= NaX + X, \\ X + Na_2 &= NaX^* + Na, \\ NaX^* + Na &= NaX + Na + h\nu, \end{aligned}$$

where X is Cl, Br or I, rather than one involving a neutral halide molecule and an excited sodium atom. Bawn has recently extended this type of work to reactions involving organic halides such as CH_2Cl_2, $CH_3.CCl_3.CH_3$, etc.

The other type of chemiluminescence to be discussed was the oxidation process appearing in the luciferin reaction already mentioned, the oxidation of the Grignard reagents, the dimethyldiacridylium salts, and many others. Two methods of approach were apparent at the discussions. Weiss adopted the more physical method, and discussed the cases where the chemiluminescence can be regarded as the reverse of photochemical dissociation ($A + B \rightleftarrows AB + h\nu$) and the quantum conditions associated with this type of reaction. Drew, on the other hand, has attacked the problem of chemiluminescence in the phthalic hydrazides from the purely chemical point of view of investigating the reactions that lead to their formation, the effects of the nature and position of substituents, and the interaction of the hydrazides with hydrogen peroxide.

The discussions as a whole were of value in making clear the precise nature of some of the important problems to be solved, and both the official meetings, and the more informal exchanges of views that inevitably take place on occasions of this kind, played their part.

J. T. Randall.

The State and Medical Research in Great Britain*

The annual Harveian Oration was delivered by Sir Edward Mellanby, secretary of the Medical Research Council, on October 18 at the Royal College of Physicians, London, the subject of his discourse being "The State and Medical Research".

Sir Edward first paid a tribute to Harvey, who "stands out as one of the greatest investigators, and his work—a wonderful combination of observation and experiment—is an example of the finest achievement of the human mind". Harvey's election in 1630 as physician-in-ordinary to Charles I brought him into close association with the head of the State, and one result of this association was permission to make use of deer and other animals in the royal demesnes for study—probably the first instance, with certain legendary exceptions, of State support for medical research. Harvey's example has induced more and more individuals to take up research, and the revolutionary changes in medicine during the past sixty years only increase the appreciation of his foresight and skill. These revolutionary changes include the introduction of new methods for the diagnosis, treatment and prevention of disease; the enormous increase in hospital accommodation; the formation and development of the clinical laboratory and radiological department; and the expansion and multiplication of the public health services.

Increase of knowledge has been mainly responsible for these developments, and it has come to be realized that health and disease are not conditions conferred upon man for his humble acceptance, but that by a certain method (Harvey's method) disease may be controlled and death itself warded off, and more and more men and women proceed to investigate and to accumulate knowledge.

The acceptance in Great Britain of the new urge for research has been comparatively recent. The late Earl Balfour said in 1896, "I have all my life

* Substance of the Harveian Oration before the Royal College of Physicians, delivered by Sir Edward Mellanby, K.C.B., F.R.S., on October 18.

been an ardent believer in a cause which is often laughed at—the cause of the endowment of research. I think there is no branch of knowledge in which it may find a more useful field of application than in that of advancing medical knowledge." Again, in 1900, Earl Balfour pointed out how meagre was the equipment for medical research in Great Britain compared with Germany, France, Switzerland and Italy. Medical research in these countries was undertaken for its own sake, and not necessarily for the elimination of disease, though the leaders of industry there and in the United States soon realized that it was to their advantage to devote some expenditure to the furtherance of research.

It has been said that Great Britain needed the stimulus of the Great War to realize the importance of research, resulting in the setting up of the Department of Scientific and Industrial Research in 1915. Actually, the Medical Research Committee came into being somewhat earlier, in 1913, under the National Health Insurance Joint Commission, to administer funds provided by the National Insurance Act of 1911. This arrangement terminated in 1919, and in 1920 the Medical Research Council took the place of the Committee, funds for the work of which were provided directly from the Treasury in the form of a Parliamentary grant-in-aid.

Sir Edward Mellanby then discussed the possible sources that might be anticipated for the endowment of research, medical or industrial. Had funds, private or otherwise, not been available, such men as Darwin, Newton, Humphry Davy and Faraday could scarcely have pursued their work and made their discoveries. On the other hand, it is true that some of the best work has been done by those labouring under conditions of extreme simplicity, notable instances being those of Claude Bernard and Louis Pasteur. Endowment of research, medical or industrial, by private individuals has been the exception in Great Britain, but the American record in this respect during the past twenty years has been a fine one, and the extensive support given to British medical research by the Rockefeller Foundation may prove a stimulus to private munificence here, of which the Nuffield scheme at Oxford is possibly an indication.

The ability to discover, Sir Edward remarked, is present in all grades of society; but the real discoverer is rare in all classes, and it should be the object of civilized communities to find him and to foster his activities. Failing adequate private endowment, all will agree that there is justification in Great Britain for State support for research. State support must, however, be associated with State control, a condition disagreeable to many owing to the fear of loss of freedom for the investigator. History, however, has clearly demonstrated that State endowment is compatible with the best type of medical research, and indeed Sir Edward stated that one of the main objects of his discourse was to show how State control of medical research can be associated with freedom to the investigator.

It is true that State control may have certain dangers, such as political influences, implicit in any State activity; not only has political influence been absent, but even political interest has been uncommon in the affairs of the Medical Research Council. While Parliament possesses ultimate control, the Council has been given great latitude in its policy and finance, and the disposal of the funds supplied is at its complete disposal. Of the present eleven members of the Council, eight are chosen for their scientific and medical attainments, each one approved by both the Lord President of the Privy Council and the president of the Royal Society; political influence has had no detrimental effect upon the medical researches controlled by the Council. A safeguard against bias and dictatorship on the part of the Council is the fact that there is constant change of personnel, each individual term of office being limited to four years.

The appraisal of a new discovery is clearly difficult, and mistakes are inevitable from time to time; it is seldom in the facts of a discovery, but rather in their interpretation, that mistakes are made, and in the Council's work more mistakes are due to benevolence than to harshness.

After this statement of the case for State support of medical research, and vindication of its impartiality in Great Britain, Sir Edward proceeded to describe the general principles guiding the actions, and the work, of the Medical Research Council. For general guidance of detailed work, the Council relies on the advice of special committees, of which there are twenty-seven at present, some being appointed conjointly with other bodies, for example with the Royal Society of Medicine (anæsthetics), the Lister Institute (vitamins), the British Empire Cancer Campaign (radiology) and others. The Industrial Health Research Board, a subsidiary of the Medical Research Council, also receives advice from committees dealing with its problems. The services of all members of these committees are given voluntarily. Sir Edward also paid a tribute to the willing co-operation of the Royal Colleges of Physicians and of Surgeons.

With regard to finance, the present annual income of the Council amounts to about £220,000, of which the State contributes £195,000, a sum

that has recently been criticized as being meagre in view of the possibilities through research of the reduction of expenditure on the country's toll of sickness, which costs the Government between 200 and 300 million pounds annually. In addition, private funds held by the Council contribute £13,000 per annum, and a sum amounting to £12,000 is derived from grants made by certain bodies for special purposes, including the Rockefeller Foundation, the Leverhulme Trustees, the British Empire Cancer Campaign and others.

The principal factor limiting research activity is personnel, and one of the endeavours of the Council is to increase the number of research workers, but more funds will be necessary when more trained investigators become available. Some system is also required for financing sudden important calls for organized research when these arise.

The Council has also established and maintains the National Institute for Medical Research at Hampstead and Mill Hill, supports a growing number of research units, both clinical and laboratory, and provides grants for individual workers. At the National Institute for Medical Research, under the direction of Sir Henry Dale, work is done in two main divisions, one including researches coming under physiology, pharmacology, and biochemistry, the other those under experimental pathology and bacteriology. Here, in addition to research, the standardization of biological products, such as antitoxins, certain drugs, vitamins, and hormones, is undertaken, whereby the exact strengths of these products may be described in terms of units, and the doctor is thus able to prescribe known amounts of their active principles.

The Medical Research Council also maintains at the Lister Institute a National Collection of Type Cultures, so that any medical man in the world can obtain at nominal cost a culture of almost any known micro-organism. At the Pathological Laboratory of the University of Oxford a Standards Department is maintained, from which preparations of bacterial suspensions and sera are supplied for use in the diagnosis of diseases, such as enteric and undulant fevers, and dysentery.

The placing of units of research in different institutions has developed with much success in recent years. The Council provides the salaries and the actual cost of the research, the institution furnishing the accommodation. There have thus been established the neurological research unit at the Hospital for Diseases of the Nervous System, Queen Square, London, the research department on puerperal infections at Queen Charlotte's Hospital, London, the clinical research department at University College Hospital, London, and others. Research grants to individuals are also made, such personal grants being usually limited to three years, and the worker is given full freedom to develop his problem. A third activity of the Council is the award of travelling fellowships in research, and a number of the younger medical men of Great Britain have been past holders of these fellowships. Assistance is also given to Government departments on problems of health and disease.

After some remarks regarding initiative in research, and a reply to criticisms respecting the type of medical research supported by the Council, Sir Edward Mellanby had something to say about the future, observing that the difficulty he foresaw was not that of obtaining knowledge, but of its application to human needs. He concluded his oration by pointing out that it is the function of the Medical Research Council to promote discovery, not to implement its application. He made an appeal to the Royal College of Physicians of London, suggesting that the College as a body and through its fellows and members might use its prestige and influence in guiding the profession and the public to appropriate action, if such be needed, when scientific discovery has supplied new knowledge of importance to public health. Finally, he submitted that the entry of the State into the field of medical discovery has been both stimulating and fruitful.

Obituary Notice

Sir Basil Mott, Bart., C.B., F.R.S.

BY the death of Sir Basil Mott on September 7, a pioneer in engineering practice, the Royal Society loses one of the few engineers who have been admitted to its fellowship. He formed a link—one of the very few remaining—with those great figures whose names became almost household words in the latter part of the nineteenth century as the creators of outstanding engineering works—Benjamin Baker, Wolfe Barry, Charles Hawksley, Douglas Fox and others. When a young man he gained experience, as a mining engineer, in work underground, which was invaluable in the pioneering work involved in deep tunnelling with the Greathead shield, the use of which has revolutionized the solution of transport problems in crowded cities. The first use of this method on a large scale was in the construction of the 'City and Southwark Subway', which formed the first part of the 'City and South London Railway' and was taken in hand in October 1886. Basil

Mott became assistant to Greathead on this work and, so much was his skill and energy relied on, that he became Greathead's partner. He had the further valuable experience of operating the railway for the first eighteen months after it was opened in December 1890.

The difficulties attendant on maintaining electric traction underground—the first time that this had been attempted—were such as to call forth to the utmost Mott's natural ingenuity and resource, and this experience proved invaluable when, some years later, he joined Sir Benjamin Baker for the construction of the Central London Railway, the first 'Twopenny Tube' from Shepherd's Bush to the Bank, which was opened in 1900. These works and others which followed were the means of establishing the practice of deep tube tunnelling as an engineering method, and the process was thereafter applied in many other cities throughout the world, where it is probable that the public who make daily use of the transport facilities provided, have little recollection of what they owe to British engineering practice in general, and to Greathead, Baker and Mott in particular.

Mott was, however, a civil engineer in the widest sense, and there are few branches of the profession in which at one time or another he did not exercise his skill. For example, he gained an outstanding reputation as a great bridge builder. He was responsible, at first in partnership with Benjamin Baker and later in sole charge, for the widening of the Blackfriars Bridge, completed in 1909. In later years, with his partners in the firm of Mott, Hay and Anderson, he was responsible for many important bridges, the Queensferry Bridge at Chester, the Wearmouth Bridge at Sunderland, Boothferry Bridge near Goole, the Newport Bridge, the Tees Bridge at Middlesbrough, and the Tyne Bridge at Newcastle, completed in 1928. Possibly the greatest of the works with which he was associated and one which very fully absorbed his time and energies in his later life, was the Mersey Tunnel, connecting Liverpool and Birkenhead, the largest under-water tunnel in the world, completed in 1934.

During the Great War, Sir Basil rendered notable service to the Government in many directions, visiting both France and India. For his services he was made a C.B. Later, his experience was of great assistance to the Ministry of Transport in connexion with the Charing Cross Bridge scheme. He also gave advice on the Channel Tunnel project and the Severn Barrage. In 1925 he was chairman of a committee of engineers and architects which took the necessary steps for the preservation and safety of St. Paul's Cathedral.

Sir Basil was born on September 16, 1859, and was educated at Leicester, in Switzerland and at the Royal School of Mines, where he won the Murchison Medal. He became a member of the Institution of Civil Engineers in 1895 and was president of the Institution in 1924. He was elected to the Royal Society in 1927, and was also an associate of the Royal School of Mines, a fellow of the Imperial College of Science and Technology and a member of the Société des Ingenieurs Civils de France. He is succeeded in the baronetcy, conferred on him in 1930, by his eldest son, Adrian Spear Mott.

CLEMENT D. M. HINDLEY.

WE regret to announce the following deaths:

Prof. L. S. Dudgeon, C.M.G., C.B.E., professor of pathology in the University of London and dean of St. Thomas's Hospital Medical School, on October 22, aged sixty-two years.

Sir Robert Mond, F.R.S., known for his researches in pure, applied and electro-chemistry, and for his archæological investigations in Egypt, Palestine and elsewhere, on October 22, aged seventy-one years.

News and Views

Mr. Sidney Smith

MR. SIDNEY SMITH, whose appointment to the recently instituted chair of Near Eastern Archæology in the University of London (Institute of Archæology) is announced (p. 806), has been keeper of the Department of Egyptian and Assyrian antiquities in the British Museum (Bloomsbury) since 1930, when he succeeded the late Dr. H. R. Hall. Mr. Smith was educated at the City of London School and Queens' College, Cambridge, of which he was a scholar and is now an honorary fellow. He took the Classical Tripos in 1911, and proceeded to Berlin for further study in 1912. In 1914 he was appointed an assistant in the British Museum; but during the Great War he was commissioned in the Middlesex Regiment, and while on active service was mentioned in dispatches. On his return to the British Museum he continued his studies of cuneiform texts, and between 1921 and 1927 published a number of volumes of texts from Cappadocia, as well as from the Babylonian historical records. In 1921 he also published an account of the first campaign of Sannacherib. Mr. Smith was a member of the British Museum's expedition excavating at Ur in 1922–23; and in 1929–30 he served as director of antiquities in Iraq. Among much other work, Mr. Smith has contributed to the Cambridge Ancient History, and initiated and edited *Iraq*, the publication of the British School of Archæology in Iraq. Since 1923 he has been lecturer in Assyriology at King's College, London.

Prof. D. H. Robertson

Dr. D. H. Robertson has been appointed to the Sir Ernest Cassel chair of economics, with special reference to banking and currency, tenable at the London School of Economics. He will take up his duties on January 1, 1939. The Sir Ernest Cassel chair of economics, instituted in 1920, was previously occupied by Prof. T. E. Gregory, who resigned in December 1937 to take up the office of economic adviser to the Government of India. Dr. D. H. Robertson is at present reader in economics in the University of Cambridge, and has been a fellow of Trinity College since 1914. His work on industrial fluctuation and on the theory of money has given him an international reputation, recognized by the conferment on him of honorary degrees by the Universities of Amsterdam and Harvard. He has been a member of the Economic Advisory Council since 1936. He co-operated with Prof. A. L. Bowley in the Economic Survey of India, 1934. Among his published works are "A Study of Industrial Fluctuations" (1915), "Money" (1922), and "Banking Policy and the Price Level" (1926).

New Wing of Queen Mary College, London

On October 12, the Chancellor of the University of London formally opened the new west wing of Queen Mary College, which has been erected upon the site of the Winter Garden of the old People's Palace. The spacious Zoology Department, fully equipped for modern requirements, occupies the top of the new wing, and apart from the usual laboratories, museum, etc., possesses a special aquarium room with marine and freshwater aquaria, and two animal rooms. The removal of the Arts Departments to the lower floors of this new wing has provided room for considerable extensions of the Departments of Botany, Geology and Physics, which occupy the east wing, although the completion of the Physics Department awaits the third and final phase of the building programme. The College is now provided nearly throughout with up-to-date modern laboratories, several of which are equipped for special lines of research. In declaring the new buildings open, the Chancellor expressed the hope that funds would soon become available for completing the building programme of the College.

Rothamsted Centenary: Inaugural Meeting

While the experimental fields at Rothamsted are probably the best known and the most interesting in the world, the laboratories, farm buildings and equipment are admittedly not up to the standard of many of the Continental or American stations, and do not allow of anything like so much scientific assistance to the farmer as should in these difficult times be available. The Committee of Management is taking advantage of the approaching centenary to remedy these various deficiencies and is hoping to raise a fund of £125,000, of which £80,000 would be used for buildings and equipment and £45,000 for addition to endowment so as to provide for upkeep of fabric and salary augmentations. The work will proceed in three stages. The first is the building of the new chemical and bacteriological laboratories, pot culture houses and farm buildings; this will cost about £45,000 of which, however, only £30,500 is drawn from the centenary fund, the remainder being provided by the Ministry of Agriculture. The second stage will be the building of the library at a cost of £20,000; and the third the erection of a new block to house the Imperial Soil Bureau, the Statistical Department, the administration and extension staff, a conference hall and staff common rooms: this will cost about £30,000. It is hoped to complete all three parts before the centenary occurs in 1943, hence the work is being put in hand as early as possible. This is being done partly also for the convenience of those who wish to spread their donations over a period of years. The scheme is being inaugurated at a meeting to be held on November 1 at the Royal Society's rooms, when His Royal Highness the Duke of Kent will preside, and when it will be announced that His Majesty the King, through the Duchy of Cornwall, will open the subscription list.

Tide Mills of England and Wales

In a very well illustrated lecture to the Newcomen Society on October 12, entitled "The Tide Mills of England and Wales", Mr. Rex Wailes gave a survey of all the mills of which he had been able to find any traces. In the course of two years he had visited the sites of twenty-three mills, and of these ten were still worked by the tides. Starting with the county of Suffolk, he described the mill at Woodbridge on the Deben Estuary, first mentioned about 1170. This mill is served by a 3,100,000 sq. ft. pond with a six-foot head. The water-wheel is 20 ft. in diameter and 5 ft. 10 in. in width and it is mounted on a 22-in. square oak shaft. It drives four pairs of mill stones controlled by a single pair of governors, the only instance of its kind. There are early references to several tide mills in London but the only ones at work are at the Three Mills Distillery, Bromley-by-Bow. Here in the House Mill are four water-wheels, and in the Clock Mill, three water-wheels, all about 20 ft. in diameter, driving in all eighteen pairs of stones for grinding maize, barley and other cereals for the production of spirits. The mills are semi-tidal, being worked as the water flows outward from the River Lea. Other mills still working are at Stambridge, in Essex, Beaulieu and Eling in Hampshire, Carew and Pembroke in Wales, and Emsworth in Sussex. The paper is printed and illustrated in *Engineering* for October 14.

Associated Learned Societies of Liverpool

The triennial public exhibition and soirée organized by the Associated Learned Societies of Liverpool and District to illustrate the progress in science and education since their last exhibition in 1935 was held in the City Technical College on October 22. During the course of the exhibition, Prof. E. W. Marchant gave a lecture on "Television", H. Kendrick on "Changing India", W. H. Watts on "The

Moon", D. Caradog Jones on "The Changing Population of Merseyside", Prof. J. T. Craig on "Veterinary Pathology", and a number of shorter talks were given in the individual rooms. The Institute of Chemistry and the Society of Chemical Industry exhibited process demonstrations of artificial silk spinning, products obtainable from cotton seed, demonstrations of the action of dirt particles under the influence of electrical forces, dyeing and armour-plate glass; the British Association of Chemists exhibited a combined temperature and humidity recorder, smoke density determination apparatus and samples from the plastics industry. The Liverpool Biological Society's room included a demonstration exhibit by Prof. J. H. Orton on his Dee fisheries work, Dr. R. J. Daniel on pearl-formation, and Mrs. Bisbee on the ductless glands. Mr. Eric Hardy had arranged a special "Country-Side" Room with Nature films, photographs, habitat groups of British birds and mammals, bird migration ('ringing') and flight (bird-wing) displays, illuminated natural colour lantern slides, bird sanctuary devices and maps of local bird distribution. The exhibition also included natural colour films, an ingenious micro-projector by Mr. A. V. Wilkinson, Dr. Glynn Morris's geological collection, and in the Engineering Society's room, a trafficator for cyclists invented by Mr. A. Robins.

Indian Adult Education

FROM the National Adult School Union we have received a copy of an appeal by its International Committee for funds to assist in the development of adult education work in India. The appeal is countersigned by Mr. Banning Richardson, as president of the Indian Adult Education Society and honorary general secretary, All-India Adult Education Conference Committee. This committee has undertaken to investigate all the adult education activities which are being carried on in India and to call a conference for the early part of 1939. Annexed to the appeal is a leaflet which mentions, as indicative of the character of the work now carried on by the Indian Adult Education Society: the teaching of improved methods of handicrafts to undergraduates of the University of Delhi with the intention that during the vacations this instruction should be passed on to their rural relations and friends; "literacy work"; a regular service of rural broadcasting; the teaching of scholastic subjects to matriculates, who have not been able to continue their studies at a university; and the giving of instruction to members in their own religion by the most capable believer in that faith available. Of this last, it is claimed that an improved relationship between the followers of the different religions has resulted. Nothing is said about the utilization of the movement as an instrument of political propaganda, but reference is made to the fact that in the Central Provinces, recently described in *The Hindu* as "a thoroughly congress-minded province", the Minister of Education and Vice-Chancellor of the University have associated themselves with it.

Royal Society of Science, Bombay

SINCE its opening in 1920, the Royal Institute of Science, Bombay, has been recognized as the foremost college in the Presidency for the training of science students. The late Dr. A. N. Meldrum, the first principal and professor of organic chemistry, realized the importance of its being not merely an institution for the training of undergraduate students, but that it should also be an active centre of research. He was fortunate in having the support of an enthusiastic staff, and during the period of his principalship a large number of students were trained in the methods of research both in the physical and natural sciences. We have now before us the triennial report of the Institute covering the years 1934–37, and we note with pleasure the continued advancement of the Institute under the energetic and enlightened leadership of its present principal, Prof. T. S. Wheeler. The total number (315) of full-time students is not large, and of these no fewer than 94 are engaged in post-graduate work, which indicates the importance attached to original work.

DURING the triennium dealt with in the report, 159 original papers have been published of which the majority (102) come from the two departments of chemistry. Whilst, as is natural, their contents are of varying value, Prof. T. S. Wheeler's contributions to the theory of liquids and Prof. R. H. Dastur's work on plant metabolism have attracted widespread attention. In its recent visit to Bombay, the British science delegation had the opportunity, all too short, of visiting the Institute and of seeing something of the work which is being so actively pursued. Contrary to the experience elsewhere in India, no difficulty has been encountered in finding employment for students, of whom only 0·6 per cent were unemployed, whilst 21·8 per cent had obtained industrial posts. It is very much to be hoped that no considerations of economy will be allowed to weaken the activities of the Institute since, to the students now under training there, the industries of the Bombay Presidency must largely look for their future advancement.

Acquisitions at the British Museum (Natural History)

THROUGH the kindness of the Rev. T. H. Wilson, of Inkongo in the Sankuru district of the Congo, the Museum has received a female specimen of the recently discovered peacock-like bird, *Afropavo congensis*. This bird was first discovered by Dr. James P. Chapin, of the American Museum of Natural History, New York, in 1936, who found two mounted examples in the Ethnological Department of the Tervueren Museum, Brussels, where they had been overlooked. Later the authorities of that Museum received further specimens from the Congo. Dr. Chapin visited the area and his native hunters brought in two more, while he himself had a fleeting view of one bird in the forest. The interesting feature of this bird is that in some of its characters it resembles the peacock, a bird which is confined to Asia. Specimens of diamondiferous gravels and concentrates have been

received from the Geological Survey of the Gold Coast Colony, and Prof. Takeo Watanabé has presented a specimen of the new mineral kotoite—a magnesium borate occurring as a rock-forming mineral in limestone in Korea. A magnificent group of yellow and green zoned crystals of fluor from a mine in Weardale has been purchased and the opportunity has been taken to re-arrange the exhibit of fluor in the pavilion of the Mineral Gallery. Mr. P. M. Game, a member of the staff of the Department of Minerals, who recently returned from an expedition to West Greenland under the leadership of Dr. H. I. Drever, has brought back a collection of about three hundred specimens of rocks and minerals from Ubekendt Island, Umanak Fjord, a region in which no previous geological work had been done.

THE Department of Botany has received two collections of plants from expeditions made by students of Imperial College. The first is from Jan Mayen, and contains 427 numbers mostly collected by Mr. R. S. Russell. The collection is a very valuable one as each number usually contains ample material. The Department now has practically a complete representation of the species recorded from the island, which is of special interest in view of its position in mid-ocean between the Old and the New Worlds. The second is from Finmark, and consists of 350 numbers of dried plants and some fungi in spirit, collected for the most part by Mr. H. D. Jordan. The specimens are mainly from the base camp area at the head of Lakse Fjord and in the still incompletely mapped hinterland, which was crossed up to a little beyond River Tana. The Oxford University Expedition to the Cayman Islands obtained 678 numbers of flowering plants and 614 numbers of cryptogams for the Department, collected by Mr. W. Kings. The specimens are well preserved, and, as the islands are little known botanically, the collection should prove an interesting one. Mr. C. A. Lister accompanied the Public Schools Exploring Society's Expedition to Newfoundland and collected 173 phanerogams and 34 cryptogams. These have been presented to the Department and supplement the previous collections made in these expeditions. The specimens are very well preserved. The British herbarium of the late Mr. F. J. Hanbury, which was bequeathed to the Museum, contains more than 20,000 sheets. As Mr. Hanbury always aimed at a large series of specimens and as he was responsible for a considerable number of records to the "Supplements to Topographical Botany", the material is especially useful. The chief value of the herbarium is probably in the fine collection of *Hieracium*, for Mr. Hanbury began the publication of a monograph of the genus and compiled the account in the ninth edition of Babington's "Manual"; it contains the *Hieracia* of James Backhouse, the first monographer of the genus in Britain. The Department has also acquired Lieut.-Colonel A. H. Wolly-Dod's collections of *Rosa*. Colonel Wolly-Dod is the recognized British authority on the genus, and many of the specimens have been examined by other specialists.

Philosophy and History

IN the annual philosophical lecture on "Some Problems of the Philosophy of History" delivered under the Henriette Hertz Trust before the British Academy on March 16 (London: Oxford University Press, 1*s.* 6*d.* net), Prof. G. C. Field urged that all serious philosophical thinking must be based on an examination of the assumptions actually made in the other established forms of thinking. If the philosopher wishes to proceed eventually to a general theory of knowledge or reality, he must take this as his foundation and evidence. Prof. Field suggested that among the established forms of thinking, history holds an important place and deserves serious consideration in view of the tendency to suggest that the assumptions of physical science must be the assumptions of all valid thinking. History forms a coherent body of thought in which mutual understanding and co-operation between large numbers of people are possible, and has independent claims to consideration as an essential part of the evidence on which our final theories must be based. Prof. Field distinguishes three main elements in the general structure of historical thinking: imaginative reconstruction of past events or situations; the belief that this imaginative reconstruction is correct, corresponding to, or being like in some degree, what really happened; and the evidence on which our conclusions are based. Discussing the dependence of our historical beliefs on narrative, he referred to the question of selection in imaginative reconstruction and its bearing on the understanding rather than the mere recording of what happened.

University of Manchester and its Alumni

THE second number of the *Journal* which the University of Manchester has established as a means of keeping its members in touch with its activities and plans maintains the high standard of its predecessor. A message and appeal to its graduates by the Vice-Chancellor is followed by a number of articles of more than local or passing interest. The School of History, the Physics Department, the University Settlement and Halls of Residence are discussed by Profs. E. F. Jacob and W. L. Bragg, Mr. Pilkington Turner and the wardens of two of the Halls. Mr. John Coatman, North Regional director of the B.B.C., writing on "The Significance of a Lancashire University in the Community", argues ingeniously that the circumstances of to-day call for a vision of international economic and political relations as clear and fruitful as that which gave Lancashire its greatness a century ago, and that, to meet this need, its universities, the county's "great intellectual power-houses", should devote themselves increasingly to the "philosophical study of the principles of human association, examination of the economic and political forces at work inside and between nations, and clear-sighted, intelligible analysis of the forces which mould public opinion, determine national policies, and thus in the end control international relations". Furthermore, he urges that in the systems of education which come within their influence they should give an increasing

bias to such studies and especially the study of the British Commonwealth of Nations, as an example of a new kind of political association between free and independent peoples, based on principles which are universally and permanently valid.

Beneficial Employment and Vocational Guidance

LOCAL education authorities will, next year, be called upon to consider applications for exemption from compulsory school attendance of children between fourteen and fifteen years of age and to determine in each case whether the employment proposed will be "beneficial" to the child. The Board of Education has suggested to local authorities, among other measures for qualifying themselves for determining these difficult questions, the requirement of a school report indicating the child's good, average and weak subjects and information regarding manual or domestic training received, and a medical report expressing the doctor's opinion as to the types of occupation unsuitable for the child—hence a widespread stimulation of interest in the principles and practice of vocational guidance, a subject in which there has been a large amount of research in America. The United States Office of Education, with the assistance of the National Occupational Conference, has prepared bibliographies of current literature in this field and recently published a "Guidance Bibliography" (Bulletin No. 37. Washington, D.C.: Supt. of Documents. 10 cents), an annotated list of 442 books, pamphlets and periodical references classified under the headings: elementary schools, secondary schools, colleges, adult and out-of-school youth, and techniques and procedures. Information as to careers is published monthly by the National Occupational Conference in an "Occupational Index".

The English Sprat Fishery

THE Ministry of Agriculture and Fisheries paper by Mr. J. Armitage Robertson on "The Sprat and the Sprat Fishery of England" (Fisheries Investigations. Series 2, 16, No. 2) deals with the economic importance of the sprat, the location of the fishery, behaviour and geographical distribution, life-history, age, sex-ratio and food. Even the health of the sprat is treated in a section devoted to 'parasites and disease', from which the sprat seems tolerably immune. The fishery is a localized inshore winter one, confined to the south coast and East Anglian seaboard, and is prosecuted in a variety of ways: by drift nets, stow-nets, trawls and seine nets. The possibility that the shoals are 'driven' shoreward by the incursion during the winter months into the Southern Bight of the North Sea of water of a higher salinity (greater than 35 per mille) than that to which they are accustomed is discussed, but Mr. Robertson is insufficiently convinced by the available data on this point and considers "that these hydrographical conditions and the circumstances of the fishery do not bear the relation of cause and effect, but are merely due to some general and common cause such as 'Winter Conditions'". In spite of a Norwegian authority's statement that English sprats are "tough, coarse and unpalatable", Mr. Robertson finds nothing to support this, and recommends as beneficial both to the fishery and to the country the development of the already existing small sprat-canning industry in Great Britain. English prices vary between 3*s*. and 16*s*. per cwt., whereas the average cost of imported canned brisling, mostly from Norway, is £6 13*s*. per cwt., so that the industry should have an ample working margin.

Radio Interference by Electro-Medical Apparatus

IN a recent article in NATURE (May 21, p. 941), attention was directed to the widespread interference caused to radio reception by various classes of electrical apparatus. One of the sources of such interference and also one of the most difficult to mitigate is a certain type of electro-medical apparatus used for diathermy treatment. With the view of securing an amelioration of conditions in this field, the Postmaster-General has asked the Minister of Health to direct the attention of local authorities to this matter. Accordingly a circular letter has been issued by the Ministry of Health to all local councils, including welfare and local education authorities (Circular 1695). With this circular was enclosed a memorandum prepared by the Radio Branch of the Post Office on the prevention of interference with radio reception from certain types of electro-medical apparatus. This memorandum has been reprinted from *The Hospital*, the official organ of the British Hospitals Association. It is to be noted that modern valve-rectified X-ray apparatus is not likely to cause interference; and the memorandum is primarily concerned with certain diathermy installations working on medium waves, short waves, and ultra-short waves which can only be prevented from causing interference by the addition of an electrical screen or Faraday cage capable of enclosing not only the apparatus but also the patient and the operator. Since no other effective method of prevention has yet been discovered, it seems desirable that, for new hospital buildings or extensions of existing hospitals or other new buildings in which these forms of apparatus are likely to be used, the inclusion of screened rooms should be considered. Attention is directed to the fact that the Radio Branch of the Post Office is prepared to advise on any problem arising and also on the prevention of interference from existing plant.

The Cheshunt Research Station

THE annual report for 1937 of the Experimental and Research Station at Turner's Hill, Cheshunt, Herts, announces a new auxiliary venture. It was recognized that the control of virus diseases of cucumbers and tomatoes could only be accomplished by the use of seed from disease-free plants. A Seed Growers' Association is therefore to be formed to carry on this commercial side of the Station's activity. A capital of £3,000 has been subscribed, and will enable the venture to start. Many experimental trials which have been prosecuted in previous years are continued to give conclusive results. Such

are the effect of restricted rooting upon early fruiting of the tomato, the use of electric light to hasten growth of cucumber seedlings, the use of soil heating for several crops, and the use of a surface rooting medium for tomatoes. Entomological investigations have included studies of rose thrips and onion thrips, and the use of a species of *Scolothrips* as a predatory control of red spider mite. Extensive mycological researches include the record, for the first time in Great Britain, of a leaf-spot of marguerite caused by the fungus *Ramularia bellunensis*. Physiological estimations of tomato seedlings have also been accomplished, and more general problems of soil nutrition have been studied.

Lighting and Speed of Seeing

A RECENT article (*Brit. Eng. Export J.*, September) describes practical advances that have recently taken place in lighting. An interesting experiment is described which shows a relation between illumination and the speed of vision. The apparatus used was a heavy pendulum on which a test object was exposed to view when swinging between two screens. The speed of movement of the object was directly proportional to its distance from the pivot. At high illuminations, the test object could be seen when it was placed at the lowest point of the pendulum. At intensities not exceeding two foot candles, it was only visible when it was placed at a distance not exceeding a quarter of the way down, when its speed is only a quarter of what it is at the lowest point. After an increase to five foot candles the speed of seeing was increased by about 60 per cent.

Model Chinese Junks

A COLLECTION of large-scale models of Chinese junks, which is said to be unique, has been presented to the nation by Sir Frederick Maze, inspector-general of Chinese customs, for exhibition in the Science Museum, South Kensington. The models, ten in number, were built in Hong-Kong or Shanghai by Chinese craftsmen, and are accurate replicas of these sailing craft in every detail, down to the shrines and household gods. They include examples with the magical eye on the prow. These boats, which are now giving place to steam in Chinese waters, and have also suffered many casualties during the present warfare, are of two main types, a northern and a southern. Except for details of rigging, they have not altered in principle over a prolonged period—at least a thousand years, and some authorities would hold for perhaps twice as long before that. Of these types, one has bluff bows and a flat bottom adapted for sailing in shallow waters. The other type has a sharp bow, with sheer lines and a deeper draught. Details of construction and rig in use among Chinese sailors at an early date are shown in these models, which did not appear in Western ships until a very much later period. Such, for example, are the watertight compartment, the battened sail used in yacht racing, lee boards of the keel and rudder types, and multiple sheets for independent handling of the upper and lower parts of the sails.

Sternberg Astronomical Institute

ACCORDING to "Russia Today" Press Service, buildings for the Sternberg Astronomical Institute of Moscow will be commenced early next year in the vicinity of Butovo Station, one of the highest points on the outskirts of Moscow. The observatory, laboratory, mechanical workshops and blocks of flats to house the staff of the Institute will occupy a site of 14½ acres. The main part of the Institute's building will contain accommodation for research workers, lecture rooms, a library for 100,000 volumes and a storehouse for the 60,000 photographic negatives taken by the Observatory and by the Southern Astronomical Station in Tajikistan. Underground in the same block will be situated the time service with its astronomical clocks, and a gravimetric laboratory. A tower, to be erected over the main body of the building, is to be used for solar work. The removal of the Institute from Moscow is necessitated by the increasing vibration caused by traffic and the reflection of the city's electric lights in the sky, which interfere with astronomical observations.

Centenary of the Greek Archæological Society

CELEBRATION of the centenary of the Greek Archæological Society began at Athens on October 23. The proceedings were opened in the Parthenon by the King of Greece, president of the Society, who delivered an address of welcome to the delegates and representatives of Greek and foreign universities and learned societies. Great Britain was represented by Mr. William Miller, of the British Academy, Mr. R. D. Barnett, of the Society for Hellenic Studies, and Mr. Gerald Mackworth Young, who was present on behalf of the Society of Antiquaries of London and the British School of Archaeology at Athens. The programme of the celebration, it is reported in *The Times* of October 24, includes excursions to Delphi, Eleusis and Epidaurus, the conferring of academic honours on distinguished archæologists, the laying of wreaths on the Cenotaph and the statue of the late King Constantine, a former president of the Society, the performance of the *Electra* of Sophocles and *King Lear*, an official banquet given by the Government, and a number of receptions.

The Night Sky in November

THE moon is full on November 7 at $22{\cdot}4^h$ and new on November 22 at $0{\cdot}1^h$ U.T. On November 7, there will occur a total eclipse of the moon under favourable conditions—given fine weather—for observation in Great Britain. Contact of the umbra with the moon's limb at position angle 94° from the north point, measured towards the east, occurs at $20^h\ 41^m$; total eclipse begins at $21^h\ 45^m$ and ends at $23^h\ 8^m$; the moon leaves the umbra at $0^h\ 12^m$ November 8, the position angle of the last contact being 243°. Lunar conjunctions with the planets occur on November $1^d\ 19^h$ (Jupiter): $5^d\ 18^h$ (Saturn) $18^d\ 18^h$ (Mars): $23^d\ 21^h$ (Mercury) and $29^d\ 8^h$ (Jupiter). There is a conjunction of Mercury and Venus on November 8, but both planets set very shortly after the sun. As the sky darkens, Jupiter is

seen as a very bright object rather low near the meridian. Saturn southe shortly after 21h in mid-November. Mars is a morning star rising at 3¼h; on November 28, the planet passes 3° north of Spica. Uranus, in the constellation Aries, is in opposition on November 8, its distance from the earth being nearly 1,736 millions of miles. The Leonid meteors should be looked for on November 15–16: the x Taurids on November 14–16 and the Andromedids from November 17 to 23. The light change of the variable star, Algol, should be seen about one and a half hours before and after the following times of primary minima: November 9d 6·0h: 12d 2·8h: 14d 23·6h: 17d 20·4h: 20d 17·2h and 29d 07·7h.

Announcements

AT the annual statutory meeting of the Royal Society of Edinburgh held on October 24, the following Council was elected: *President:* Sir D'Arcy Thompson; *Vice-Presidents:* Prof. F. A. E. Crew; Lieut.-Col. A. G. M'Kendrick; Principal J. C. Smail; Prof. J. Walton; Dr. James Watt; Prof. E. T. Whittaker; *General Secretary:* Prof. James P. Kendall; *Secretaries to Ordinary Meetings:* Dr. A. C. Aitken and Dr. C. H. O'Donoghue; *Treasurer:* Dr. E. M. Wedderburn; *Curator of Library and Museum:* Dr. Leonard Dobbin; *Councillors:* Dr. J. E. Mackenzie; Prof. Sydney Smith; Prof. R. Stockman; Prof. Lancelot Hogben; Prof. James Ritchie; Dr. G. W. Tyrrell; Prof. C. T. R. Wilson; Prof. R. C. Garry; Prof. R. J. D. Graham; Prof. D. Murray Lyon; Dr. J. E. Richey and the Hon. Lord Robertson.

JUNIOR research fellowships in tropical medicine have recently been awarded by the Medical Research Council to the following: Dr. S. G. Cowper, A. J. Haddow, and W. H. R. Lumsden. The fellowships are tenable for three years, during the first two of which the holders will undergo training in Great Britain in tropical medicine and in the use of research methods.

AN inscribed stone has been fixed at No. 32, Soho Square, W.1, recording the fact that Sir Joseph Banks, president of the Royal Society, and Robert Brown and David Don, botanists, lived at the house which formerly stood on the site, and that the Linnean Society met there from 1821 until 1857 (see also NATURE, 139, 280; 1937).

AN earthquake of moderately large proportions was recorded on seismographs in England on October 19d. 4h. 22m. 54s. G.C.T. Mr. J. J. Shaw's record was uncertain owing to interference by the wind. The Kew record indicates an epicentral distance of approximately 53·3°, but the azimuth is uncertain. No damage has been reported.

ON October 22, Lieut.-Colonel Mario Pezzi regained for Italy the height record for aeroplanes by flying to a height of 17,074 metres. The previous record, held by England, was that of 16,440 metres, attained by the late Squadron Leader M. J. Adam. The Italian flight was made in a Caproni machine fitted with a specially constructed Piaggio engine, details of which are not disclosed.

PROF. F. F. NORD, of the University of Berlin, known for his contributions to the chemistry of enzymes, heterogeneous catalysis and cryolysis of colloids, has accepted the chair of organic chemistry in Fordham University, New York, N.Y. Prof. Nord will continue to be editor of *Ergebnisse der Enzymforschung*.

THE following have recently been elected members of the Imperial Leopold Caroline German Academy at Halle: Dr. Philipp Stöhr, professor of anatomy at Bonn; Dr. Richard Siebeck, professor of internal medicine at Berlin; Dr. Paul Wels, professor of pharmacology at Greifswald; Dr. Georg Stetter, professor of physics at Vienna; Dr. Abraham Esau, professor of technical physics at Jena; Dr. Fritz Kohlrausch, professor of physics at Graz; and Prof. Walter Schoeller of Berlin.

AN industrial fellowship has been established by the Elgin National Watch Company, Elgin, Illinois, at the Mellon Institute, Pittsburgh, Pa. The research programme will cover broadly the chemical aspects of technical problems in the watch industry. One of the first subjects of investigation will be watch lubrication. Dr. George E. Barker, of the Massachusetts Institute of Technology, has been appointed to the fellowship. Before joining the Institute's research staff, Dr. Barker spent several years in the synthetic organic chemical industry.

THE foundation stone of an institute of hygiene, social medicine and industrial pathology has recently been laid at Brussels.

ACCORDING to the National Safety Council of the United States, in the first four months of 1938 there were 2,060 fewer traffic deaths than in the corresponding months of 1937, or a reduction of 19 per cent.

OWING to the recent crisis, the second International Congress of Radio-Æsthesia which was to have been held in Paris on October 17–19 has been postponed to November 7–9. Further information can be obtained from the Secretariat, 9 rue Etex, Paris 18e.

THE third Italian Congress of Medicine and Sport will be held at Genoa on November 12–14, when discussions will be held on the reduction of professional capacity from internal lesions following sport and reduction of working capacity from injury to the locomotor system.

THE Congress of Rheumatism organized by the French League against Rheumatism, which was to have been held on October 8, has been postponed until December 3. Further information can be obtained from the Secrétariat de la Ligne française Centre le Rhumatisme, 23 rue Cherche Midi, Paris, 6e.

Letters to the Editor

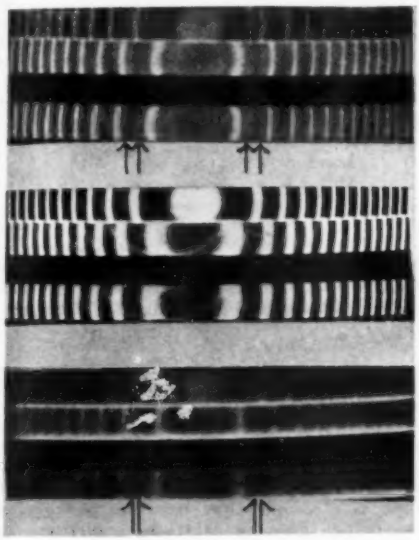
The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 799.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Debye Heat Waves in Highly Viscous Liquids

FOR the spectroscopic study of the light scattered in solids and fluids using interferometers of high resolving power, it is very important to be able to work with a light source giving sharp and intense spectral lines without accompanying hyperfine structure components or continuous spectrum. A zinc–mercury amalgam lamp in 'Pyrex' glass has been developed in this laboratory by one of us (C. S. V.) which gives the zinc triplet of lines 4680, 4722 and 4811 A., satisfying these requirements. It may be run continuously for days together without trouble, and is found to be a great advance on the ordinary mercury arcs for such investigations.



1. Phenol 2. Direct light 3. Glycerine

A very surprising and interesting result obtained using the zinc–amalgam lamp is the discovery that the light scattered backwards even by such a highly viscous liquid as glycerine at 20° C., when analysed with a Fabry-Perot étalon, exhibits well-defined Brillouin components on either side of the incident lines, along with a continuous background. A similar result is also shown by liquid phenol at room temperature. These facts are illustrated in the accompanying reproductions (1 and 3), 2 being the corresponding pattern for the zinc triplet in the incident light. It will be noticed that the undisplaced lines in the scattered light are very intense relatively to the accompanying Brillouin components. The failure to observe these latter components with glycerine and phenol at room temperatures in earlier investigations[1] with the mercury arc is readily understood; with the mercury radiations, the hyperfine structure of the undisplaced central line would completely overwhelm the much feebler displaced components in the scattered light.

The viscosity of glycerine at 20° C. is 8·3 poises, and if this viscosity were effective in the propagation of compressional waves having a wave-length comparable with that of the incident light, these waves would be so highly damped that they could have no physical existence, and the corresponding Brillouin components would therefore be unobservable. The fact that the latter are actually to be seen, and indeed are quite sharply defined, seems to indicate that the usual hydrodynamic viscosity has little influence on the propagation of thermal sound waves of very high frequencies.

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[1] Raman, C. V., and Rao, B. V. R., NATURE, **139**, 585 (1937); **141**, 242 (1938).

Mathematics of Air Raid Protection

IN view of the discussion which is occurring on this subject, it seems desirable to have some quantitative measure of the degree of protection afforded by a given shelter. In order to limit the problem we may consider only risks of death, and further confine ourselves to high explosive bombs. Incendiaries have proved a negligible danger to life in Spain, and gas is also negligible except for babies and those whose respirators do not fit.

Consider a given type of bomb, say, a 250 kilo. bomb, which is commonly used on central areas of Spanish cities, and a man in a given situation, whether in the street or in a shelter. Let n be the expected number of bombs falling in his neighbourhood (say, 1 square kilometre) during a war, the distribution of bombs over this area being supposed even, since aim is poor when cities are bombed. Let p be the probability that a single bomb falling at the point (x,y) in this area will kill him. Then the probability that he will be killed in the course of the war is $P = \frac{n}{A}\int p\,dx\,dy$, integration being taken over the whole neighbourhood of area A.

The values of n and p will, of course, be different for each type of bomb, and the different expressions so obtained must be summed. Further, the man will be in different places during the war, and thus another summation is necessary. Finally, P must be summed for the whole nation.

The policy of evacuation is intended to reduce the value of n, even though it may increase that of p, as when a child is evacuated from a fairly solid house into a flimsy hut. The policy of dispersal within a dangerous area does not, of course, reduce either n or p. It merely ensures that no single bomb will kill a large number of people, while increasing the probability that any given bomb will kill at least one. It is likely to save a few lives by equalizing the numbers of wounded to be treated in different hospitals; and the psychological effect of having 20 killed in each of 10 areas may perhaps be less than that of 200 killed in one area. But as it may actually increase the mean value of p by encouraging people to stay in a number of flimsy buildings rather than one strong one, it is at least as likely to increase the total casualties as to diminish them. The argument that a number of people must not be concentrated in one place in order that a single bomb should not kill hundreds is clearly fallacious when applied to a war in which the total casualties will be large. It is, however, true that a small group of key men each of whom can replace another should not be grouped together.

The effect of shelters is to diminish the mean value of p, which approaches zero in a deep tunnel, and is maximal in an open space with a hard surface which bombs will not readily penetrate. The component of p due to splinters is large in the open, but negligible in any shelter worthy of consideration, though not so in the average brick house. In general, the construction of shelters should have two aims, namely, to diminish p in the immediate neighbourhood where a bomb falls, and to diminish the area over which p has a value large enough to be taken into consideration.

With a good many types of shelter, p approaches unity within a certain area, and zero outside it. Thus in a trench with protection from falling splinters p is nearly unity if a bomb falls in the trench, and nearly zero if it does not. In these cases it is clear that P depends mainly on the area of a straight section of trench, and is about seven times as great in a trench 70 feet long by 6 feet wide as in one 16 feet long by 4 feet wide. This fact has largely been neglected in the construction of trenches in our parks.

Again, a shelter with a roof of concrete one foot thick will give $p = 0$ for very light bombs; a fractional average value of p for medium bombs which will not penetrate the roof before explosion, but will knock down a portion of it on explosion; and $p = 1$, or nearly so, for heavy bombs with delayed action, which will penetrate the roof and burst in the shelter. It follows that the area of such shelters should be minimized, or they should be divided up by very stout walls, for example, reinforced concrete walls at least a foot thick. This is not in order to diminish the number who may be killed by a single bomb, but to diminish the area within which a bomb must fall so as to kill a given individual.

It would seem that, in the design of many shelters, too much stress has been placed on vertical protection, that is to say, protection from bombs falling immediately on the individual's protection, and not enough on horizontal protection; that is to say, protection from bombs falling at some distance from them.

I suggest that, for each type of shelter, it should be possible to arrive at a rough value of P/n per square kilometre, and that such values would be of great utility in the design of shelters, though I regard any shelters for which this value is not very close to zero as inadequate. Thus, to take definite examples, the value of P/n for a straight covered trench 5 metres by 1 metre would begin at about 9×10^{4} for 20 kgm. bombs, supposing that such a bomb would kill everyone in the trench if it fell within 30 cm. of it. It would rise to about 4×10^{-4} for a bomb making a crater of 10 metres in diameter. The same value, for a square shelter of 100 square metres with a concrete roof 30 cm. thick but thin walls, would rise from nearly zero for a 20 kgm. bomb to about 8×10^{-4} for a heavy bomb making a 10 m. crater. These figures could, of course, be improved; and are only presented as approximations. But they suggest that in an area where heavy bombs are likely to be used the trench is to be preferred. On the other hand, were the concrete shelter divided into a number of cells by stout walls, it would be safer than the trench.

Only by such quantitative treatment can we expect to avoid mistakes in policy and design of shelters such as have occurred and are still occurring. It is, however, to be hoped that these calculations may be rendered needless by the provision of completely bomb-proof shelters such as exist in some Spanish towns.

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Oct. 14.

The Arms Race of 1909–13

THE interaction of fear with cost and with grievances was represented in a letter in NATURE (Dec. 25, 1935) by the equations

$$dx/dt = ky - ax + g\ , \qquad dy/dt = lx - \beta y + h, \qquad (1), (2)$$

in which t is time and α, β, k, l are positive constants, and g and h are positive or negative constant grievances. In that publication, x was described as the variable preparedness for war of the first group of nations, y that of the second. But on further consideration, it appears that the description of x given in 1935 needs to be modified by taking into account the co-operation between the groups of nations which goes on as trade, travel and correspondence concurrently with their mutual threatenings. The improved description of x is in general terms

$$x = \text{threats minus co-operation.}$$

In the hope of reaching quantitative measures, let us try

$$x = U - U_0\ , \quad y = V - V_0, \qquad (3), (4)$$

in which U is the annual defence budget for the first group of nations, V that for the second group, and U_0, V_0 are measures of co-operation. U, V, U_0, V_0 are all here expressed in million pounds sterling. As a tentative assumption, let U_0, V_0 be regarded as constants during the arms-race (5).

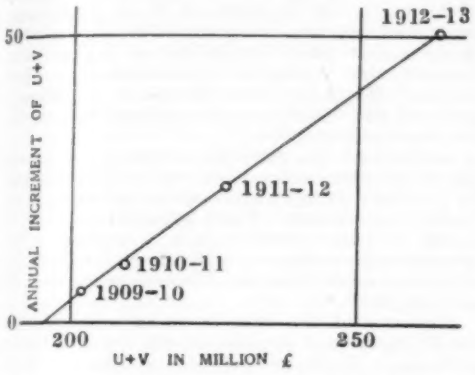
In 1909 France was allied with Russia, Germany with Austria-Hungary. These two pairs of nations were very roughly equal, so that we may simplify (1) and (2) by putting $k = l$, $\alpha = \beta$. Then, by addition, it follows that

$$\frac{d(x+y)}{dt} = (k-\alpha)(x+y) + g + h\ ;$$

and by substitution of (3), (4), (5)

$$\frac{d(U+V)}{dt} = (k-\alpha)(U+V) + \{g+h - (k-\alpha)(U_0+V_0)\}.$$

This implies that when $d(U+V)/dt$ is plotted against $U+V$, we should expect a straight line of slope $k-\alpha$. The statistics for Austria-Hungary have been taken from the "Statesman's Year Book", those for the other countries from a pamphlet by Per Jacobsson[1]. The accompanying diagram shows that the four points lie close to a straight line of slope $k-\alpha = 0{\cdot}73$ year^{-1}. Furthermore, by a short extrapolation, the line cuts the axis of zero $d(U+V)/dt$ at $U+V = 194$. This 194 million sterling is the amount of defence expenditure, by the four nations concerned, that would just have been mutually forgiven in view of the amount of goodwill then existing.



It is, to say the least, a remarkable coincidence that the trade between these opposing pairs of nations was on the average 206 millions sterling, close to 194.

A much fuller discussion is due to appear under the title "Generalised Foreign Politics". In particular, the assumption that U_0, V_0 were constant cannot be expected to remain valid for long periods of time. Also the budgets are variously stated.

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[1] Jacobsson, "Armaments Expenditure of the World," *The Economist*, London.

Resonance Absorption of Slow Neutrons

WE have made measurements of the position of the resonance levels of some heavy elements for slow neutrons. The method is a development of that of Preiswerk and v. Halban[1], and depends essentially on finding how much paraffin must be traversed by neutrons in order to have their energy reduced from that of the resonance level of the element under investigation to that corresponding to known periods of silver or rhodium. In this way definite evidence has been obtained for resonance levels in cobalt, bismuth, lead, thorium, uranium, besides the known ones of silver and gold. The most interesting result is that two levels can be detected in bismuth, the first at about 1 volt, the second at about 11 volts. As bismuth is a pure element, both levels represent high excited states of radium E. Preliminary experiments with thorium and uranium give similar results, showing for thorium two levels, in the neighbourhood of 2 and 18 volts respectively, and for uranium levels about 5 and 30 volts. With cobalt we find a level at about 1 volt and nothing else of any intensity up to 40 volts. While it will require a careful study of the experimental conditions before these resonance energies can be fixed with certainty, we think these results give a trustworthy picture of the separation of energy levels in heavy elements. Such values are quite compatible with current theoretical ideas, as is also the suggestion of greater separation for the lighter element cobalt, and an increase in the separation as the first level goes to higher energies.

It seems likely that the interesting anomalous absorption of slow neutrons in boron, recently reported by Michiels[2], can be explained by the existence of two resonance levels in iodine. He finds, using iodine as a detector, that the absorption coefficient in boron is greatly altered if iodine is used as an initial filter instead of boron. If we assume, to a first approximation, that energy losses are unimportant, then the use of a sharply resonating detector effectively reduces the experiment to the investigation of the absorption of a heterogeneous beam consisting of as many homogeneous components as the detector has resonance levels. Suppose I_1 and I_2 are the initial intensities of the low- and high-energy components, τ_1, τ_2 and μ_1, μ_2 their absorption coefficients in iodine and boron respectively, and d_1 and d_2 the thicknesses of the iodine and boron filters, then the smaller boron absorption coefficient with iodine filtering means that $(\tau_1-\tau_2)d_1$ is greater than $(\mu_1-\mu_2)d_2$. The approximate constancy of the boron absorption coefficient with increasing boron filtering and on the other hand its decrease with increasing iodine filtering, means that $\tau_2 I_2/\tau_1 I_1$ is much less than $e^{-(\mu_1-\mu_2)d_2}$ but comparable with $e^{-(\tau_1-\tau_2)d_1}$. Such relations are quite plausible, but a closer analysis is not justified unless great care is taken to allow for the scattering. The pronounced effect of different arrangements is shown by the divergence between Michiels' results for iodine filtering and those of Ruben and Libby[3]. On the evidence available, it appears as if iodine has two levels, one in the neighbourhood of 40 volts and the other of several hundreds of volts.

The significance of the change in activity when two filters of boron and iodine were used simultaneously, first in one order, and then reversed, can only be appreciated when all scattering effects and losses of energy in any hydrogenous material present are carefully taken into account, but it must be remembered that similar effects were found in the early days in the experiments on the absorption of heterogeneous γ-ray beams.

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Sept. 14.

[1] Preiswerk and v. Halban, *C.R.*, **201**, 722 (1935).
[2] Michiels, NATURE, **142**, 431 (1938).
[3] Ruben and Libby, *Phys. Rev.*, **51**, 774 (1937).

Viscosity of Light Hydrogen Gas and Deuterium between 293° K. and 14° K.

IN connexion with previous systematic investigations[1] on the viscosity of gases at low temperatures, we have studied hydrogen and deuterium gas. As is well known, such investigation is interesting in connexion with the theoretical calculations made respectively by Uehling[2] and Massey and Mohr[3].

As in our previous investigations, we used the oscillating disk method, with very small plate distances. Considering the results obtained for light hydrogen ($T = 293°$ K., $\eta \times 10^7 = 882{\cdot}7$; 89·4°, 387·1; 77·3°, 345·8; 20·3°, 108·8; 18·5°, 102·4; 16·7°, 90·3; 15·1°, 80·8; 14·1°, 74·5), it will be observed that our results are in good agreement with the results obtained by Kamerlingh Onnes, Dorsman and Weber[4] and by Sutherland and Maass[5]. The values published recently by Keesom and Macwood[6] for the viscosity of light hydrogen at liquid hydrogen temperatures are about 20 per cent higher. On the other hand, the values obtained by Vogel[7] and Günther[8] are about 10 per cent smaller than our values and those of Kamerlingh Onnes, Dorsman and Weber.

From our measurements on the two kinds of hydrogen, we determined the ratio η_{D_2}/η_{H_2} as a function of temperature. So we obtained at $T = 293°$ K., $\eta_{D_2}/\eta_{H_2} = 1{\cdot}39$; 90°, 1·34; 80°, 1·35; 75°, 1·35; 20°, 1·24; 17°, 1·24; 15°, 1·24; 14°, 1·25.

Thus at room temperature the ratio η_{D_2}/η_{H_2} is in good agreement with the ratio of the square root of the molecular masses of the two molecules. At lower temperatures there is a regular decrease in this ratio. This decrease cannot be attributed to the presence of a small per cent of H_2- in the D_2-gas.

More details on these measurements will be published shortly.

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Aug. 19.

[1] van Itterbeek, A., and Keesom, W. H., *Physica*, **2**, 97 (1935); *Comm. Leiden*, No. 235a., van Itterbeek, A., and Claes, A., *Physica*, **3**, 275 (1936); van Itterbeek, A., and Keesom, W. H., *Physica*, **4**, 257 (1938); *Comm. Leiden*, *No.* 252a.
[2] Uehling, E. A., *Phys. Rev.*, (2) **46**, 417 (1934).
[3] Massey, H. S. W., and Mohr, C. B. O., *Proc. Roy. Soc.*, A, **141**, 434 (1933); **144**, 188 (1934).
[4] Kamerlingh Onnes, H., Dorsman, C., and Weber, S., *Comm. Leiden*, No. 134a; *Proc. Kon. Akad. Wet. Amsterdam*, **15**, 1386 (1913).
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Absorption of Gases by Tantalum

Hydrogen. A number of workers have measured the absorption of hydrogen by tantalum; thus Pirani[1] found a large absorption at yellow heat, Moers[2] measured the quantity taken up at higher temperatures, while Fetkenheuer[3] found a maximum in the absorption at about 600° C. On the other hand, Sieverts showed a curve[4] in which the quantity taken up was greater at 20° C. than at higher temperatures. The clean-up at low pressures does not appear to have been discussed in detail, although Balke stated[5] that below 1 micron the clean-up was very small.

We have studied the clean-up of hydrogen at pressures from 1 micron to 30 microns on a tantalum strip of area 2 cm.[2] and mass 50 mgm. If the strip was degassed at temperatures below 1,500° C., surface oxide remained present. In this state the clean-up was as found by Fetkenheuer[3]. It was negligible below 400° C., reached a maximum at 600° C., and decreased again, becoming very small at 1,000° C. The absorption at 600° with a pressure of 1 micron was only about $\frac{1}{4}$ cu. mm. measured at S.T.P. If, however, the strip was run in a very high vacuum for a long period at 1,900° C. or for a short period at 2,200° C., further gas was evolved, the strip became cleaner in appearance, and the clean-up of hydrogen was profoundly modified. The maximum absorption now occurred at 20° C. as found by Sieverts[4], while there was a continuous decrease in absorption from 100° C. to 1,000° C. as in Sieverts' curve. The clean-up was very rapid, the total quantity cleaned up at 1 micron pressure and 20° C. being about 20 cu. mm. measured at S.T.P. The clean-up was proportional to $\sqrt{P}$ from 1 micron to 30 microns; if proportionality continued to atmospheric pressure, the absorption at that pressure would be 17·5 c.c. If this is expressed in c.c. of hydrogen per gm. of tantalum, the figure is 350 c.c./gm., which is about seven times Sieverts' figure. It is probable, however, that saturation occurs below atmospheric pressure. All the gas cleaned up at 20° C. was liberated again at 950–1,000° C., and was partially liberated at lower temperatures.

Above 1,200° C., absorption appeared to increase again, although measurement was difficult on account of the rapid formation of atomic hydrogen at the higher temperatures. There appeared to be an increase to about 1,700° C., and a decrease above, absorption becoming negligible above 1,900° C. The maximum absorption was, however, much less than that at 20° C.

Exposure of the strip at room temperature to small pressures of oxygen restored the first type of behaviour. Exposure at 600° to oxygen led to this type of behaviour in a more marked degree, with a very small clean-up of hydrogen at 600°. Prolonged running at 2,200° C. was then necessary to restore the second type of behaviour.

Nitrogen. Variable results have also been obtained on absorption of nitrogen by tantalum[6,7]. We have found that after running at 2,100° C. in high vacuum, clean-up of nitrogen at 1 micron appears at 700° C., and is very rapid at 1,000° C.; it remains constant from 1,000° to 1,500° C., and decreases at higher temperatures. All the gas cleaned up at 1,000° is liberated at 2,100° C. and is partially liberated above 1,900° C. The absorption at 1,000° C. was not determined exactly, but was certainly greater than 25 c. mm. measured at S.T.P. when the pressure was 3 microns.

A strip in the oxidized condition after degassing at 1,500° only showed no absorption of nitrogen below 850° C., while absorption only became rapid above 1,200°. This result is that obtained by Moissan[7]. Thus in the case of both hydrogen and nitrogen, the earlier variable results have been due to contamination of the tantalum surface by oxide. Similar degassing treatments were found necessary in work on the thermionic and photo-electric properties[8,9].

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Aug. 29.

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[2] Moers, *Metallwirt.*, **13**, 640 (1934).
[3] Fetkenheuer, *Siemens Z.*, **12**, 168 (1932).
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Variation in the Longitudinal Incremental Permeability due to a Superimposed Circular Field

DURING the course of an investigation of the variation of the longitudinal incremental permeability by a superimposed circular magnetic field, some rather interesting results were obtained with certain iron-nickel alloys. The ferromagnetic materials under investigation were of wire form and served as the core of a long slender solenoid. Direct current was passed through the core to produce the circular field, and the longitudinal permeability was calculated from inductance measurements on the solenoid.

Using well-annealed alloys, it was found that rather large increases in the longitudinal incremental permeability could be obtained as a function of a relatively small superimposed circular field, while upon twisting the conducting core a gradual change from an increase to a decrease in the incremental longitudinal permeability as a function of a superimposed circular field was obtained.

These effects are shown in Fig. 1 where curve (*a*) gives the variation of the inductance of the solenoid as a function of the direct current through the conducting core of an unstrained sample. Curve (*b*) is that obtained after the core has been twisted through 120°. Here the inductance of the solenoid without any core is 1·3 millihenries. In all measurements the effect of the earth's field was reduced to a minimum and the samples were completely demagnetized before each run.

Fig. 2 shows the variation in longitudinal incremental permeability of the core as a function of the

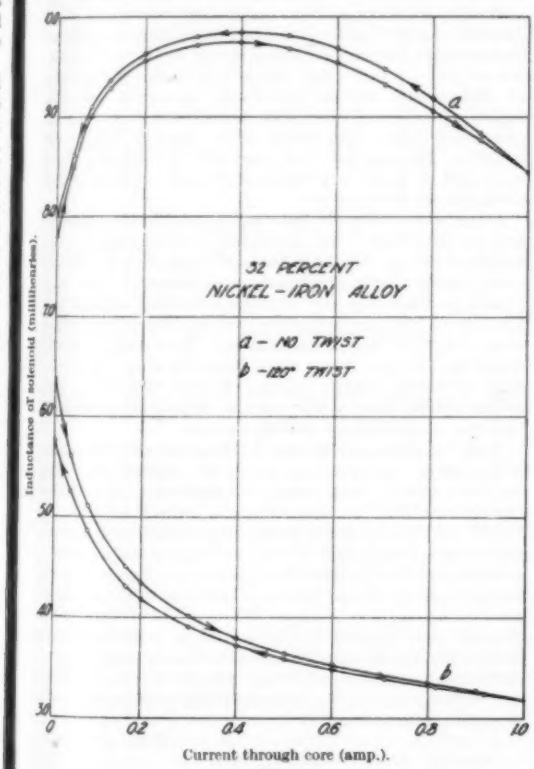

Fig. 1.

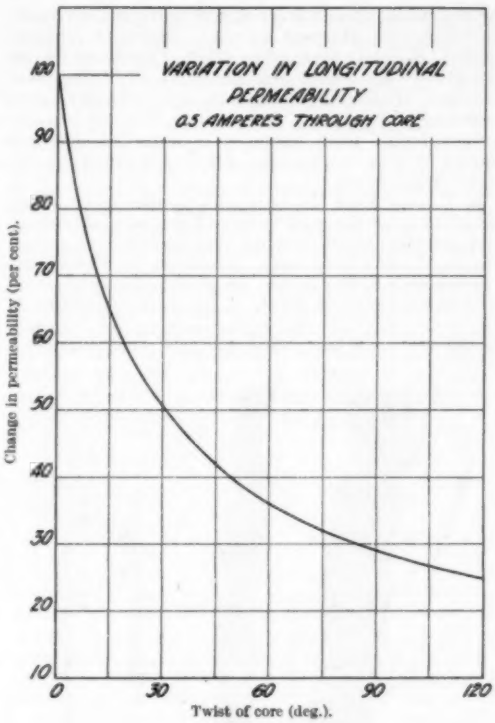

Fig. 2.

degree of twist when a current of 0·5 amp. passes through the core. Variations in permeability thus obtained on the samples were much greater than those obtained by twisting when no current passes through the core.

These large variations in inductance, obtained as a function of the current through the core or as a function of the degree of twisting of the core while carrying a definite current, appear to have many possible applications.

A complete account of this work covering all of the more common ferromagnetic materials will be given elsewhere.

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Aug. 31.

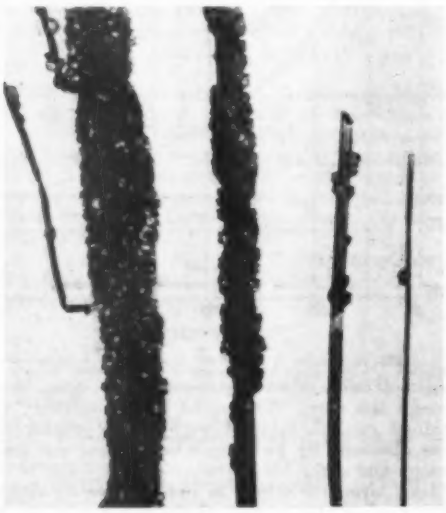
Barnacles in Horsey Mere

ON July 15, 1938, it was discovered that there were large numbers of the barnacle *Balanus improvisus* Darwin, living on the stems of the reeds in Horsey Mere, Norfolk. The water of Horsey Mere and Hickling Broad has been very saline since the sea broke through last spring on February 12, March 1 and April 4, and estimations of the salinity of the surface water on August 6, made by Mr. A. J. Rudd of the Norfolk Fishery Board, were: Horsey 18·19 per mille, Hickling varying from 21·0 per mille (north end) to 17·5 per mille (Whiteslea).

The fauna of the area is now an interesting mixture of brackish water and freshwater species. On August 2,

the following species were found amongst the reeds on which the *Balanus* occurs: *Hydrobia jenkinsi* Smith*, *Bythinia tentaculata* (L.)*, *Theodoxus fluviatilis* (L.)*, *Gammarus zaddachi* Sexton*, *Corophium volutator* (Pallas)*, *Sphæroma* sp., *Membranipora monostachys* Busk, var. *fossularia*. The only aquatic insects found were larvæ and pupæ of *Donacia cinerea* Herbst, which were fairly numerous on the roots of the reeds.

In Horsey Mere the barnacles appear to be distributed all over the reed beds and are very abundant. The greatest density occurs next to the open water, where thick stems and rhizomes of *Phragmites communis* and *Typha* are often completely covered in barnacles from a depth of six inches downwards, as on the left of the accompanying photograph. Inside the reed beds they become more scattered,



but they occur right inshore on littoral stones, and on thin stems down to 0·2 cm. in diameter as on the right of the photograph. The reeds are mostly alive, and have green shoots showing. Barnacles are present also in Hickling Broad and Heigham Sound, but in very small numbers compared with Horsey Mere. Near Whiteslea Lodge we found them mainly down near the roots of the reeds, and there was no dense coating on the stems.

Most of the barnacles were sexually mature on August 2, containing either ripe sperm and ova, or nauplius larvæ, and many *Balanus* nauplii were found in the plankton of Horsey Mere. Taking the carino-rostral diameter as the index of size, the specimens are up to 1·1 cm., and the average of fifty examples, which were chosen as not being deformed through overcrowding, is 0·83 cm. The maximum size of the specimens collected on July 15 is 0·9 cm., but the average of fifty is only 0·57 cm. A few young individuals, less than 0·3 cm., were found on both dates, and these must represent the first of the second generation.

Gurney[1,2] records this species in the Bure opposite Muck Fleet, where the water is "generally almost fresh". It is possible that the nauplii reached Horsey by the Thurne, which is a tributary of the Bure, on an abnormally high tide, but the fact that the adults are so abundant in Horsey, and comparatively scarce in Hickling, suggests that they came direct from the sea during one of the break-throughs in the spring. A few *Balanus* nauplii were found in a sample of the plankton from Horsey Mere on February 20. Nauplii of *B. improvisus* have been recorded in the Zuider Zee as early as January 6, and so they may have reached Horsey during any one of the three break-throughs. Breemen[3] has shown that individuals of this species may contain embryos three months after they have settled.

It seems that *B. improvisus*, which is a southern species, is killed by too low temperatures, so the barnacles may be killed off if there is a sufficiently severe frost at Horsey this winter. On the other hand, it is a very euryhaline species, and occurs in Holland in water of salinity down to 1·65 per mille, so that so far as salinity is concerned this species will probably survive in Horsey Mere and Hickling for several years. Now that it is so well established, it might even survive there under normal conditions, since the water is always slightly salt.

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* Species kindly identified by Mr. G. I. Crawford.

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Irritant Exudation from a Millipede

WHILE working at Sigi, 1,500 feet below the East African Agricultural Research Station at Amani, Tanganyika Territory, one evening in June, I came across one of the giant black millipedes—a species of *Spirobolus*—which are fairly common in this region of tropical evergreen rain-forest. It was an unusually large specimen, fully twelve inches in length. Having no box capable of holding it, I buttoned it up in my hip-pocket and continued my work for an hour or so.

I felt the millipede moving about in my pocket and noticed that I was becoming rather sore in that neighbourhood, but paid little attention to it. However, whilst bathing shortly afterwards I was surprised to find that my skin had become completely blackened over an area of about nine square inches, with further red inflammation spreading rapidly down my thigh. Four days later all this blackened skin sloughed away, leaving a raw wound. This happened in June 1937; at the end of August 1938 the site of the injury is still visible.

I have since examined millipedes of the same and other species on several occasions, and noticed that, when one is molested by being turned about in the fingers, small drops of liquid are exuded from pores, one on the side of each segment. This liquid is rich yellow brown in colour and stains the fingers like iodine; it has a characteristic pungent odour recalling that of nitrogen peroxide, but is neutral to litmus. The fumes cause marked watering of the eyes. Mere contact of the fluid with the tough skin of the fingers produces no injurious symptoms, although when some was rubbed on to the skin of the leg, smarting was experienced and the skin eventually became hard and scaly.

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Record of *Typhlocaris Galilæa*

Two specimens of the blind prawn, *Typhlocaris galilæa*, were obtained recently from the cistern of the water-mill near Tabgha at the north end of the Sea of Galilee. This species had been reported as being exterminated by drainage operations. It appears probable that the species normally inhabit a dark cave or grotto formed by a hot sulphur spring, and the specimens obtained by me were stragglers which were carried out into the cistern.

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Blood Groups among the Khasis

THE Khasis are inhabitants of the district of Khasia and Jaintia Hills, Assam. They are short statured with a high mesocephalic head, a mesoprosopic face and a mesorrhine nose, and in the height of the root of the nose above the level of the orbit they are pro-opic. The head varies from long to medium and has a high vault. The hair is of medium growth, straight and black in colour. The forehead is vertical and medium in height. The depression of the nose is shallow and the nasal bridge is concave. The malars are prominent and there is no alveolar prognathism. The lips are of medium thickness, the chin ordinary and the angle of the lower jaw medium. The eye colour is light brown and the eye slit is horizontal.

Samples of blood were collected from fifty individuals—male, female and children. The percentage ratios in groups are given below and compared with others :

	O	*A*	*B*	*AB*
Khasis	46·6	15·6	33·3	4·5
Japanese	44·8	29·9	23·7	9·8
Negritoes (Grove) ..	48·5	33·3	14·1	4·0
Indians	31·3	19·0	41·2	8·5

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Isolation of an Anhydro *l*-Galactose Derivative from Agar

IT has been found possible to methylate agar by direct treatment of the polysaccharide with methyl sulphate and sodium hydroxide solution. The product had OMe, 33·0 per cent, $[\alpha]_D^{18°}$ −93·1° in chloroform and it contained no sulphur.

Methylated agar is easily hydrolysed by boiling with 2 per cent methyl-alcohol hydrogen chloride, and the hydrolysate contains little or no methyl lævulinate. Thus, the hydrolytic products from methylated agar (14 gm.) contained only a very small amount of ester which was separated as the barium salt (0·18 gm.). The mixture of glycosides was separated, by distillation, into three fractions : Fraction 1 was a mixture of the α- and β-forms of 2 : 4 : 6-trimethyl methyl-*d*-galactoside, identical with that already separated by Percival and Somerville[1] from methylated agar. Fraction 2 was a mixture of 1 and 3. Fraction 3 was collected in five successive fractions the constants of which were sufficiently close to warrant the assumption that no great difference in composition existed among them : OMe, 37–40 per cent. On further methylation with methyl iodide, each of these sub-fractions yielded a crystalline derivative which had the composition of a dimethyl anhydro methylhexoside. It is recognized as 2 : 4-*dimethyl* 3 : 6-*anhydro methyl* l-*galactopyranoside* for the following reasons.

It shows the properties characteristic of 3 : 6-anhydro methylhexosides (cf. Peat and Wiggins[2]) in that it is hydrolysed by cold acid and is unaffected by prolonged boiling with sodium methoxide solution. It was possible to compare the substance with 2 : 4-dimethyl 3 : 6-anhydro methyl *d*-galactopyranoside, which had been synthesized in this laboratory for another purpose (Haworth, Jackson, and Smith, unpublished work). The comparison established that the two were optical enantiomorphs :

	Product from agar	Synthetic product
Melting point	82–83°	82–83°
$[\alpha]_D$ in chloroform ..	+85·3°	−86·6°
$[\alpha]_D$ in water	+73°	−76°
$[\alpha]_D$ in cold dil. sulphuric acid	+77·8 → −21°	−69·4 → +20°

Dr. E. G. Cox, of this department, reports : The complete identity of the X-ray photographs of single crystals of the two substances, coupled with the rotational data given above, shows that the two are enantiomorphs. Further, calculation of the molecular weight from the X-ray data indicates that the substances are monomeric in the crystalline state.

Hydrolysis of the galactoside from agar yields 2 : 4-*dimethyl* 3 : 6-*anhydro* l-*galactose*, m.p. 114°. The corresponding product from the synthetic *d*-galactoside has m.p. 115°.

The existence of *l*-galactose in agar was demonstrated by Pirie[3], who isolated hepta-acetyl *dl*-galactose by the acetolysis of agar, and experiments are now in progress to determine whether the 3 : 6-anhydro-ring structure which is present in methylated agar exists preformed in the original polysaccharide.

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Sept. 22.

[1] *J. Chem. Soc.*, 1615 (1937).
[2] *J. Chem. Soc.*, 1088 (1938).
[3] *Biochem. J.*, **30**, 369 (1936).

Isolation of an Anhydro-Sugar Derivative from Agar

SINCE by the kindness of Prof. W. N. Haworth we have learnt that a publication on agar is shortly to appear from the Birmingham laboratories*, we feel it desirable that one aspect of our researches on the subject should be communicated here.

Accompanying the 2 : 4 : 6-trimethyl methyl-galactoside obtained by the hydrolysis of methylated agar with methyl-alcoholic hydrogen chloride, we reported[1,2] the presence of a syrup (*c.* 25 per cent) which appeared to be a dimethyl methylketoside. Further work has now shown that this portion is not homogeneous, since it can be partially separated into two fractions by extraction with boiling light petroleum, and these fractions in turn are also

* Added on proof : Hands and Peat, *Chem. and Ind.*, **57**, 937 (1938).

mixtures. The portion insoluble in light petroleum ($[\alpha]_D^{20°} = -20°$ in chloroform), on complete methylation can be divided into two fractions, a crystalline body (*X*), and an oil, whilst the soluble portion ($[\alpha]_D^{20°} = +40°$) can be distilled in a high vacuum to yield two fractions: (*A*) of b.p. 160°/0·09 mm. (bath temp.), $[\alpha]_D^{20°} = +59°$ in chloroform; and (*B*) of b.p. 178° (bath temp.)/0·09 mm. $[\alpha]_D^{20°} = +25°$. Complete methylation of these subfractions gave rise to a mixture of (*X*) and an oil from (*A*) and a large yield of the crystalline material (*X*) from (*B*). In the same way the syrup obtained from the mother liquors after recrystallization of the 2 : 4 : 6-trimethyl methylgalactoside was partially transformed by methylation into (*X*).

On account of the difficulties in manipulation, it is not easy to estimate precisely the yield of this substance (*X*), but it appears to be about 16 per cent of the weight of methylated agar employed. It is non-reducing and has b.p. 85–90°/0·05 mm., m.p. 81° and $[\alpha]_D^{20°} = +75°$ in water and +85° in chloroform. Analysis showed it to have the composition $C_6H_7O_3(OCH_3)_3$ and it is therefore a dimethyl anhydro methylhexoside. It gave a strong Seliwanoff test and simulated a furanoside on account of the ease of removal of the glycosidic residue by dilute mineral acid; it was found that hydrolysis to the free anhydro-sugar ($[\alpha]_D^{20°} = -23°$) took place by contact for 24 hours with *N*-sulphuric acid. This resembles the behaviour of the 3 : 6-anhydro-2 : 4-dimethyl methylglucoside of Peat and Wiggins[3], so that although the positive Seliwanoff reaction seemed anomalous, the chance that it might be a 3 : 6-anhydro-galactose derivative was considered. By the direct methylation of 3 : 6-anhydro-α-methyl-galactoside prepared by the method of Ohle and Thiel[4], the corresponding 2 : 4-dimethyl derivative was prepared. This substance was obtained as an oil, b.p. 90°/0·05 mm., $n_D^{20°} = 1{\cdot}4640$ and $[\alpha]_D^{20°} = +87°$ in chloroform. It is important to note that both these 3 : 6-anhydro-galactosides give the Seliwanoff reaction.

Although hydrolysis of the 2 : 4-dimethyl 3 : 6-anhydro-α-methylgalactoside in cold *N*-sulphuric acid was complete in 24 hours, the equilibrium value reached was $[\alpha]_D^{20°} = +22°$ instead of −23°, and although the general properties of the two substances are so similar that it is probable that the natural product is a 3 : 6-anhydride, it is clearly not 3 : 6-anhydro-2 : 4-dimethyl α-methyl-*d*-galactoside, and further synthetic experiments will be necessary to decide its constitution. The fact that the specific rotations of the free dimethyl anhydro-sugar from agar and of 2 : 4-dimethyl 3 : 6-anhydro-*d*-galactose are approximately equal and opposite in sign makes it possible that the sugar concerned is not *d*- but *l*-galactose; this sugar has already been found in agar by Pirie[5].

These experiments fail to support the suggestion previously advanced[3] that a ketose is present in the hydrolysis products of methylated agar, although accompanying (*X*) is an oil of high methoxyl content which may be a fully methylated ketose; but little reliance can be placed on colour reactions in this case since the syrup may still contain a quantity of (*X*).

It is impossible at present to decide whether the anhydride ring is preformed in agar or whether it is the result of side reactions. However, the former view is considered to be the most likely because of the low methoxyl and acetyl contents of methylated and acetylated agar, which can be explained by the presence of the anhydro-hexose residues in the chain form each carrying only one hydroxyl free for substitution. The anhydro-hexose is clearly not an 'end group', since if it were, simple hydrolysis would set free the dimethyl anhydro-methylhexoside, whereas actually further methylation is necessary after hydrolysis. It is hoped to report upon the precise nature of the supposed 3 : 6-anhydro-dimethyl hexose and of the other unidentified products in due course.

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Oct. 5.

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Multiplanar Cyclohexane Rings

ON bromination, the isomeric forms of 1-carboxy-4-methyl*cyclo*hexane-1-acetic acid (m.p. 173° and 137°)[1] furnished monobromo acids, which gave the corresponding hydroxy acids on being heated with aqueous sodium carbonate. Oxidation of the hydroxy acids with alkaline permanganate gave rise, however, to isomeric forms of 4-methyl*cyclo*hexane-1 : 1-dicarboxylic acid, which depressed each other's melting points. Similar observations were made in the 3-methyl*cyclo*hexane series.

A full report of these experiments will be published in due course.

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[1] Desai, Hunter, Ghulam Khan and Saharia, *J. Chem. Soc.*, 416 (1936).

Combustion Pressures in Spark-Ignition Engines

IT has come to the notice of investigators interested in combustion and detonation in spark-ignition engines that the combustion pressures may attain values which, even when no heat losses are considered, appeared to surpass those found by calculation, making use of the normally accepted data for such processes. The inadequacy of pressure indicating apparatus, especially when measurements were made under conditions of incipient or even persistent detonation, has for long prevented adequate attention being paid to this phenomenon.

Repeated measurements on different engines with Farnboro, quartz and capacity type indicators have now shown that the pressure rise over the compression pressure may in several cases be up to 50 per cent higher than is accounted for by classical calculations. The extreme cases occur when there is a certain degree of detonation, the phenomenon being then sometimes, though not always, accompanied by superimposed pressure vibrations; when these vibrations occur, the value cited relates to the mean value of the pressure.

These pressures being sustained beyond the period of vibration either of the gas mass or of the indicator, they must be considered as static pressures, to be

accounted for by external energy of the combustion gases, for which it may be assumed that temporarily the specific heat of the combustion gases is much lower than normal. This may be explained by an excitation lag theory[1], which states that in the case of combustion imparting chemical energy to a gas other than monatomic, this energy is first absorbed as translatory energy. It may be thought that this would apply especially in the case of the nitrogen of the charge. Both the pressure of the gas and its rate of heat transfer to the combustion chamber walls being dependent on the translatory energy, these findings may explain to some extent the mechanical and thermal damage due to detonation.

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[1] Lewis, B., *Z. phys. Chem.*, B, **19**, 536 (1932). Lewis, B., and von Elbe, G., *J. Chem. Phys.*, Feb. 1935; see also discussion on paper by Rassweiler-Withrow, *SAE. Journal*, April 1935.

Vitamin E Deficiency in the Suckling Rat

IN a paper recently published[1], I have shown that the characteristic defects in the offspring of vitamin E - deficient rats may be cured by administering to them concentrates of the vitamin. It seemed important to confirm that this curative action is due to vitamin E and not to some other constituent of the concentrates derived from natural sources. This I have now done by administering 2 milligrams of synthetic *d-l*-tocopherol (Roche) to the offspring of vitamin E - deficient rats.

This further observation that the synthetic vitamin produces the same curative effects as the concentrate from natural sources, taken in conjunction with my previous publications, shows conclusively that the missing factor in the milk of vitamin E - deficient does is vitamin E.

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[1] Barrie, M. M. O., *Biochem. J.*, **32**, 1467, 1474 (1938).

Points from Foregoing Letters

BY means of a zinc – mercury lamp which gives sharp spectral lines without accompanying hyperfine structure components or continuous spectrum, Sir C. V. Raman and C. S. Venkateswaran find that the light scattered backwards by glycerine and by phenol exhibits well-defined Brillouin components on either side of the incident lines. The authors infer that the viscosity of glycerine, as usually measured, has little influence on the propagation of thermal compression waves of very high frequencies.

Prof. J. B. S. Haldane gives a formula for the probability that a given individual would be killed by an explosive bomb, and calculates roughly the efficiency of various types of shelters and trenches against light and heavy bombs.

A graph is submitted by Dr. L. F. Richardson showing that during the arms race of 1909–13 the increase in expenditure for armaments of France, Russia, Germany and Austria combined followed a linear relation with reference to time. Dr. Richardson connects this with his previously deduced formula expressing the interaction of fear with cost and with grievances in international relations.

By means of paraffin absorption measurements, A. E. Downing and Prof. C. D. Ellis estimate the position of the resonance levels for slow neutrons in several heavy elements. In bismuth they find two levels (at 1 and 11 volts respectively) corresponding to high excited states of radium E. Thorium and uranium likewise show two resonance levels each, while with cobalt only one (at about 1 volt) was observed. Iodine appears also to have two resonance levels, which might explain the anomalous results recently reported by Michiels.

The viscosities of hydrogen and heavy hydrogen gas at various temperatures between 293° K. and 14° K. have been determined by A. van Itterbeek and Miss A. Claes. They find that at room temperature the ratio between the viscosities is proportional to the ratio of the square roots of the molecular weights of the two molecules, but at lower temperature the ratio decreases.

The absorption of hydrogen and nitrogen gas by tantalum at very low pressures ('clean up') at different temperatures is described by D. A. Wright. The absorption is considerably modified by the presence of surface oxide, which explains the various results reported by previous investigators.

Large increases in the longitudinal incremental permeability of a wire made of iron-nickel alloy (serving as core of a solenoid) is found by J. S. Webb, when a direct current is passed through the wire so as to produce a superimposed circular field. The author submits graphs showing the variation of the inductance of the solenoid as a function of the direct current through the conducting core and also the variation of the longitudinal incremental permeability when the core is twisted through various angles.

P. F. Holmes and M. G. M. Pryor report the presence of large numbers of the barnacle *Balanus improvisus*, upon reeds in Horsey Mere, Norfolk, following upon increased salinity of the water brought about by the temporary break-through of the sea during the storm of last spring.

The percentage ratio of various blood groups among the inhabitants of Khasia and Jaintia Hills, Assam, derived from an examination of fifty individuals, is given by Captain R. N. Basu and compared with the blood group distribution among Japanese, Negritoes and Indians.

S. Hands and Dr. S. Peat report the presence in methylated agar-agar of a derivative of 3 : 6-anhydro *l*-galactose, which is isolated as the crystalline dimethyl 3 : 6-anhydromethyl-*l*-galactoside. Evidence is given in support of the constitution assigned to the latter substance. E. G. V. Percival, J. C. Somerville and I. A. Forbes have likewise isolated from agar an anhydro-sugar derivative which preliminary investigations indicate to be *l*-galactose.

Research Items

Possession Rite in a Deccan Village

Bara Gari, "the Dragging of the Twelve Carts", a village ceremony, was witnessed by Mr. K. de B. Codrington at Fardapur, a Mahratti-speaking community in the Deccan, India, in 1932 (*Man*, October 1938). An engagement is made before the shrine of the goddess Marimata, "the Mother of Pestilence", that the rite will be carried out, if certain prayers are granted. This is usually on account of prolonged illness, on behalf of children, or above all because of barrenness. In the last event, one of the men of the household must shoulder the undertaking, as only men take part, though the women are profoundly interested, and ceremonially prepare the participants by rubbing them with turmeric. The women also make offerings at the shrine. The ceremony is evidently a family rite. On this occasion six carts only took part. They were tied head to tail, the first being an old-fashioned field cart with long shaft, obviously necessary for the ceremony. At sundown the protagonists were led by their womenfolk to the Hanuman temple, from which all village ceremonies begin. Thence they were conducted back to the Marimata shrine by one of its guardians. Of the participants two were boys of about nine or ten years old, the third a youth of eighteen. Each protagonist was escorted to the shrine between two men holding his arms. The youth was already under the influence of possession. They entered the shrine, then each came out in turn with his escort and circumambulated the line of carts at a run. Each bore a tray with a number of lighted cotton-wicks. The upper part of the body was then rigid and the eyes fixed. The boy on reaching the head of the first cart was lifted in the air by his supporters, and the cart affixed to his waist-cloth and waist-rope by the loop on the cart shaft, to which two hooks had been fastened. The cart then moved forward towards the shrine for about ten yards, accompanied by frenzied shouting and drumming. The boy's feet were not on the ground and his body took the strain, while the main motive power was supplied by men pulling on the wheel spokes and others behind the yoke.

Prehistoric Cave Men in Texas

A cave 45 miles north of the town of Dryden in the West Texas Big Bend country, which was occupied by man at some remote period, has been excavated by Mr. Frank M. Setzler, of the Smithsonian Institution, Washington, D.C. In a preliminary report issued by the Institution, it is stated that the evidence of occupation suggests that the cave may have been used for ceremonial brewing. It was discovered by Mr. Setzler when searching for evidence of an ancient people—the longest headed people yet recorded. The slope at the front of the cave was covered with talus which contained large fragments of fire-cracked limestone. These had been used by the inhabitants of the cave for heating in the fire for cooking purposes and then thrown out. The cave was explored by a trench seventy feet long, which was carried to a depth of six feet. The deposits included an unusual number of cooking stones, pointing to an exceptional use. It is thought this unusual feature of the deposits may have been occasioned by the use of the cave for brewing the juice of the sotol plant to make a fermented drink, which the Indians were found to use when the white man first penetrated this country. In the deposits were also found cooked animal bones, though these were not so numerous as might have been expected, and hundreds of characteristic arrow-heads, scrapers, drills and stone knives.

Social Motives in Economic Activities

Classical economics is largely based on the psychological premise that in their economic activities people shall be considered as solely actuated by the motives of personal material gain. During the period of the greatest industrial expansion ever known, this theory expressed and co-ordinated the thinking of industry and trade for more than a century; but it has now exhausted much of its usefulness, and in so far as it tends to direct attention away from other factors, it has become a danger. According to T. N. Whitehead (*Occupational Psych.*, **12**, No. 4; 1938), it is necessary to develop an organic conception of society in which economic activities take their place as one important aspect of the whole social process. It is impossible to be acquainted with the intimate working of an industrial plant without becoming aware of a complex network of human relations which have no place in the formal organization of the plant and yet without which co-ordinated human activity could not take place. There is no human motive more widely found or more constantly active than the desire to have a significant place in the group for which the member has a high regard. Fundamentally, the urge is to be doing significant things together with other people. To insist on the importance of social motives is not to deny the existence of those motives that are predominantly individualistic. The writer illustrates by a consideration of the failure of so many wages' schemes based on a too simple application of one motive, and also of high-pressure emotional advertising. If a small part of the money now spent in industrial research were devoted to the methodical observation of human relations in business, then a social science might be developed of vital importance to our industrial civilization.

Secretory Activity of the Liver

The frog's liver perfused with a saline solution can secrete natural and artificial pigments in concentrations many hundred times those in the perfusate. This activity is confined to dyestuffs, some carbohydrates, for example inulin, passing through without any change at all in concentration. Höber and Moore (*Proc. Amer. Phil. Soc.*, **78**, 587; 1938) have tested the effects of large numbers of organic substances on this secretory function of the liver. Sugars, polyhydric alcohols and amino acids inhibit liver function, and can be classed generally as substances having a strong affinity for water, as being surface inactive, and as causing dehydration of hydrophil colloids. On the other hand, substances which are surface active, such as the salts of the bile acids, the

carbamates and saponin, act as stimulants to hepatic secretion. The authors suggest that the activity of the liver cells might be regarded as being increased or decreased according as the condition of the cell colloids is altered in the direction of higher or lower dispersion. With this idea in view, they have compared the action of these substances on liver secretion with their effects on emulsions of lecithin and on the injury potentials of muscle and nerve. In general, there is good agreement. Substances which stimulate the liver have been found to evoke injury potentials, and to increase the dispersion of lecithin emulsions and vice versa.

Medical Research in South Africa

THE work, research and routine, of the South African Institute for Medical Research, Johannesburg, is summarized by the director, Sir Spencer Lister, in his annual report for 1937, recently published (Johannesburg: South African Institute for Medical Research, 1938). Studies on pneumonia and the types of the pneumococcus that occur in natives on the mines, and on prophylactic immunization against pneumonia, have been continued. A large number of rodents examined for the presence of plague infection yielded only three positive results, the smallest figure recorded for positive cases since 1920. The preparation of anti-plague serum by means of inoculation with avirulent living vaccine has been shown to yield a serum of greater potency than by other methods. A search for bovine strains of tubercle bacilli causing tuberculosis in human beings has been continued, but not a single bovine type has been found among ninety-eight strains isolated from non-pulmonary cases of tuberculosis, cases which in Great Britain not infrequently yield the bovine type of tubercle bacillus.

Transference of Induced Food Habit

THE third of a series of papers on the transference of induced food habit from parent to offspring by the late Miss D. E. Sladden has recently appeared (*Proc. Roy. Soc.*, B, **126**, 30; September 23, 1938). Owing to the death of Miss Sladden in 1937, the preparation of the manuscript is solely the responsibility of H. R. Hewer, who also devised the type of experiments carried out by Miss Sladden and discussed in her previous papers (*Proc. Roy. Soc.*, B, **114**, 441; 1934; **119**, 31; 1935). This paper now records the results of a series of experiments carried out by Miss Sladden over a period of six years. Two sets of stick insects, one reared on privet in every generation but tested for their ability to accept ivy in each generation, the other reared on ivy in every generation after having been tested for their ability to accept it by identical tests, have demonstrated different relative tendencies to accept ivy as a food plant. Those forced to eat ivy from the first generation onwards rapidly developed an increased ability to accept this food plant. Those reared on privet continuously displayed, during the first four filial generations, an increased ability to accept ivy but to a much less extent than did the ivy-fed stock. In the fifth and sixth filial generations ability to accept ivy displayed a decrease and a distinct annual periodicity which is only slightly shown by the ivy-fed stock. It is concluded that the forced ivy-feeding has induced in the stick insect the increased ability to accept ivy in succeeding generations.

Humus and Plant Resistance to Disease

UNDER a different title ("Insects and Fungi in Agriculture"), Sir Albert Howard has recently published a very stimulating discussion of this topic (*Empire Cotton Growing Rev.*, **15**, July 1938). His thesis is that insects and fungi are not the true causes of plant diseases; these result from poor nutrition, disease resistance being the natural reward of healthy and well-nourished protoplasm. "The first step is to make the soil live by seeing that the supply of humus is maintained." Sir Albert then stresses the significance of the return of humus to the soil by means of the conversion of vegetable refuse into humus as in the Indore process. He points out the remarkably rapid improvement resulting when humus is applied to derelict plantations of tea, rubber, etc., results that are so striking that it is difficult to attribute them to the response of the crop to better soil tilth, etc. He concludes that the effect must be connected with the proper development of mycorrhiza in the roots, and during a recent tour of tea plantations in India and Ceylon, in co-operation with Dr. Rayner, he obtained additional evidence pointing in the same direction. Sir Albert suggests that the fungus component may enable the rapid transfer of accessory growth substances from the soil to the host plant, but this ingenious suggestion remains at present purely speculative.

Inducing Polyploidy by the Use of Colchicine

THE recent introduction of colchicine as a means of inducing polyploidy has led to many experiments with various plants. Dr. H. Dermen (*J. Heredity*, **29**, No. 6) has recently described experiments and summarized the literature. Aqueous solutions of colchicine ranging from 0·1 to 1 per cent were applied to buds of *Rhoeo discolor* with a camel-hair brush. All parts of the flower were affected, but the effect was most striking in the filamentous hairs on the stamens, the end cells being affected most of all. In material collected eight days after treatment, one end cell had undergone three successive doublings of the chromosomes, increasing the number from 12 to approximately 96. Other cells in the same hair had only been doubled once or twice. In somatic cells of the anther, cells were observed having about $32n$ and in one case $64n$ chromosomes, indicating as many as five successive divisions of the chromosomes without cell division, owing to destruction of the spindle mechanism. The meiotic chromosomes normally form a ring or chain of twelve. The treatment caused the formation of $4n$ cells with univalent chromosomes and other abnormalities. Pollen grains were produced which, judging from their size, were n, $2n$, $4n$ and even $8n$. Diploid pollen grains were also obtained by changes of the plants from greenhouse temperature to cold or warm. There was a lowering in the viscosity of the cytoplasm, which remained more fluid even after cell division was resumed. Suggestions are made for producing polyploid pollen grains, embryos, seedlings and growing tips by colchicine or temperature changes.

Travel-Times of the Seismic Waves *P* and *S*

UP to, and including, the 1929 readings, the Zöppritz-Turner tables were used at Oxford for the reduction of observations and determination of

epicentres for the International Seismological Summary. For the 1930 readings and afterwards, the Jeffreys-Bullen tables have been used. The change was necessary on account of errors in the older tables brought into greater prominence by improved instrumental performance at observatories throughout the world. Dr. A. W. Lee has now performed a very useful service to seismology by examining critically the I.S.S. published data for well-observed 'normal focus' earthquakes for the years 1930–31 (Meteorological Office. *Geophys. Mem.* No. 76, 9; 1938). It was found that, for the 146 shocks considered, the travel times of the *P* waves agreed well with the Jeffreys-Bullen 1935 tables. The travel times of the *S* waves were rather different, and departures from the tables were examined for errors in identification, variations in focal depth, and errors in the tables. In this work recourse was also made to original seismograms obtained at Kew. It was determined that the *S* observations are generally later than the tabulated times at distances less than 28°, but beyond this they agree better with the tables as amended by Jeffreys in 1936. For epicentral distances less than 12° there may be confusion in identification owing to the pulses arising from reflections and refractions within the granitic, intermediate and basic layers of the earth's crust. Between 12° and 28° it is now generally agreed that there is often a small pulse preceding that usually called *S*. Lee prefers to continue calling the large, easily recognized pulse *S*, and, although he does not discuss all the possibilities with regard to the preceeding pulse, makes a very important statement that all discontinuities in the earth need not necessarily be horizontal ones. In view of the above deviations of the 1930–31 observations from the Jeffreys-Bullen 1935 and Jeffreys 1936 tables, Lee gives a new table for *S*. His table for *P*, *S*, and *S*–*P* differences should be very useful to observers at stations who are required to give details of an epicentre quickly without communicating with other observatories.

Geocentric Distances in Seismology

SINCE the advent of frequent radio time signals and greatly improved timekeeping, the arrival times of various earthquake waves at observatories have been much more accurately determined, and at most observatories can now be determined accurately to a fraction of a second. This makes apparent certain systematic errors in the determination of epicentres, and one of these is concerned with the departure of the figure of the earth from a true sphere. It has been suggested that one method of circumventing this is to use geocentric instead of geographic co-ordinates for this work. In order to facilitate the change-over from geographic to geocentric co-ordinates, and afterwards to use geocentric co-ordinates, Dr. K. E. Bullen, of Auckland, New Zealand, has produced in recent years a number of very valuable tables. One was "Tables for Converting Geographic into Geocentric Angular Distances" published by the British Association in 1938. The latest is "Tables for Reduction of Apparent Travel-times of Seismic Pulses PKP, PKP_2, SKS (corresponding to the use of Geographic Latitudes)". This is printed as *Bulletin* No. 134 of the Dominion Observatory, Wellington, New Zealand (extracted from *New Zealand J. Sci. and Tech.*, 19, No. 11, 708–13; 1938).

Anomalous Spark Discharges between Large Electrodes

IN the official overseas edition (in English) of the September issue of the *Journal of the Institute of Electrical Engineers of Japan*, there is a suggestive paper by Y. Ishiguro and Y. Gosho on the anomalous spark discharges which sometimes take place between large electrodes when the distance between them is large. The curves connecting the disruptive voltages with the distance between the electrodes, instead of being smooth, are sometimes irregular, for which there seems no obvious explanation. Until quite recently, it was customary to neglect entirely the anomalous points on these curves. From the point of view of ordinary high-voltage engineering, a method of computing the potential gradients for anomalous results had not yet been found. In 1929, Carrol and Cozzens published through the American Institute of Electrical Engineers some anomalous results obtained with spherical electrodes. Ishiguro and Gosho find with disk electrodes of great size very pronounced anomalous results. The disks are curved slightly at the edges. They have found that the phenomena varied from day to day. If the electrodes were left idle for several days, the only treatment received being the wiping away with a clean cloth of the visible dust which had accumulated on them, the experiments showed that the anomalies were greater in some cases than in others. In one experiment the maximum anomalous voltage was 124 when the normal voltage was 346. The authors have made an attempt to calculate accurately the maximum potential gradient when anomalies occur. Tolpler's explanation, given in 1932, applies well to the author's experiment; but unfortunately, in his own experiments, in order to obtain larger effects, he had sprinkled dust particles on the electrodes, whilst in the authors' experiments they kept the electrodes clean. They have found that the anomalous results may be decreased either by coating the electrodes with transformer oil or with carbon tetrachloride liquid.

Suggested Relativity Experiment

IN NATURE of July 2, p. 40, a letter was published from Mr. F. H. C. Smith, suggesting that a test of the relativity postulate that the speed of light is independent of the motions of its source and of the observer, should be made by measuring the speed of light from approaching and receding stars by Anderson's development of the Kerr cell method. Sir Shah Sulaiman reminds us that he also considers the use of non-terrestrial light as of fundamental importance in testing relativity. In his paper (*Proc. Nat. Acad. Sci. India*, 7, 85; 1937) he declared "for this experiment [the Michelson-Morley experiment] monochromatic light produced on the Earth has been used so far . . . any experiment in which *terrestrial* light is used is inconclusive and does not therefore prove the postulate of Relativity. . . . Light from the Sun should first be passed through a series of prisms (as in a monochromator), then all other light, except that with the chosen wavelength, intercepted by obstacles, and only nearly monochromatic light allowed to fall on a plane reflector and then directed into the Michelson-Morley Apparatus. Although the intensity will be diminished, there will be a greater facility to observe the interference fringes. I earnestly appeal to experimenters to repeat the experiment with Solar Light . . . I venture to make the prediction that *there will no longer be the null effect.*"

Weather Prediction in India

A SYMPOSIUM on weather prediction was held at Poona on July 25–26 under the auspices of the National Institute of Sciences of India. The problem was discussed in its various aspects, namely, seasonal forecasting in India, air-mass analysis and short-period weather forecasting with special reference to the forecasting of nor'-westers in Bengal, use of upper air data in weather forecasts, latent instability in the atmosphere and its consequences, rainfall due to western disturbances and the associated upper air temperatures, weather forecasting for aviation with special reference to local forecasts and kinematical methods in weather forecasting.

The president, Prof. M. N. Saha, in his opening remarks, referred to the development of synoptic charts in India from the time of Blanford and Eliot, and to the many new methods in the art of weather prediction introduced in India. Dr. C. B. Normand reviewed the complexities of the problem which the meteorologists have to face. At one time the practical forecaster could devote most of his time to consideration of rainfall. Now airmen want forecasts of upper winds, of height of cloud, of fog, dust-storms, sudden squalls. There is this variety of requirements, and yet the decisions of the forecaster have to be made quickly; there is no opportunity for lengthy calculation. A hopeful method of analysis—one which is now a live issue among meteorologists—is to focus attention on the identification of air masses and to picture how the different homogeneous air masses should interact at their boundaries and behave within themselves. India is the country in which the subject of seasonal forecasting has been most intensively studied, and yet the utmost one can do at present is to give a very general indication of total rainfall over a large area for a period of 2–4 months. The proper assessment of success in weather forecasting is not so easy as one would imagine at first sight. Every forecaster—amateur, professional or quack—finds some of his forecasts turning out correctly, if he forecasts often enough, and yet it is a curious fact, as pointed out by Sir Gilbert Walker some years ago, that "while the forecasting efforts of a charlatan are judged by their occasional successes, it is the occasional failures of a Government department which are remembered".

The first forecast of the monsoon rain, which was mainly based on the snowfall on the Himalayas and the Suleman range during the preceding January to May, was issued by Blanford in 1886. Gradually Eliot added other factors, the south-east trades at Mauritius, Zanzibar and Seychelles, data from South Australia and Cape Colony, and 'Nile flood'. His method involved interpretations that were liable to personal bias. The first forecast using a regression equation was made in 1909 by Walker. In 1924, Walker worked out six formulæ for forecasting rains in the Peninsula, north-east India and north-west India, in which use was made of twenty-eight factors selected out of a large number after applying his statistical test. To these, Field proposed the addition of a factor of special interest, as it indicated the way to a new source of seasonal indicators, namely, the upper winds and the upper air; his prognostic factor for the winter rains over northern India is the upper wind of the autumn over Agra. The re-examination of the data in recent years, and the application of various statistical tests, have revealed a diminution of the significance of some of the factors. Nevertheless, the total correlation coefficient is still 0·63 for the total monsoon rain of the Peninsula and 0·64 for that of north-west India and 0·72 for the winter rain of north-west India. In presenting the above review of seasonal forecasting in India, Dr. S. R. Savur said that the methods of correlation are strictly applicable only when all the quantities correlated are distributed normally. To overcome this defect, general methods are being developed. The theory, however, is still in its infancy.

The method of forecasts for ten-day periods developed by Franz Baur, of the German Meteorological Service, which rests on a combination of statistics and synoptics, as well as the 'composite-map method' of forecasts developed by Multanovsky and his collaborators, in which the time interval for the forecast is determined by the period which marks the type of the synoptic process involved, were explained by Mr. S. Basu from the point of view of their possible application to Indian conditions.

Air mass analysis received a good deal of attention. Dr. S. N. Sen explained the methods adopted in India for the identification of the different air masses; these are, broadly speaking, of two classes, oceanic and continental, but it is possible to divide them into several sub-classes. He showed certain types of stationary fronts which often develop over the Indian area.

A great help in identifying the different air masses is the drawing of stream-lines and trajectories of air at different levels deduced from pilot balloon and cloud movements, a method which is now in daily use. Information about upper air temperatures and humidities whenever available helps to make the identification more certain. Dr. K. R. Ramanathan explained how 'warm fronts' somewhat similar to those met with in European latitudes are associated with depressions and storms in the Bay of Bengal. The two air masses between which the front forms in the Bay of Bengal are the dry, cold air from north India and the moist equatorial air from the south Bay of Bengal. A modified type of 'front' or partition zone is associated with storms of the pre-monsoon season. Monsoon depressions tend to form on the zone between fresh monsoon air and old monsoon air, the former behaving as a cold mass and the latter as a warm mass. Dr. S. K. Pramanik gave an application of air mass analysis to the problem of forecasting nor'-westers in Bengal, and Mr. S. P. Venkiteswaran discussed certain relationships between upper air temperatures over Agra and distribution of rainfall during passage of western disturbances.

The role of latent instability in the atmosphere in the development of thunderstorms, dust storms, etc., formed the subject of an interesting communication by Dr. N. K. Sur. This term (defined by Normand in NATURE of October 3, 1931, p. 583) refers to a certain thermodynamical state of the atmosphere in which, in suitable circumstances, an expenditure of a small amount of energy leads to a release of a large

amount of energy. Absence of latent instability is associated with dry fine weather with occasional high clouds of non-convectional type, and its existence usually with convective types of clouds like cumulus or cumulo-nimbus or with dust or thunderstorms.

Mr. Krishna Rao discussed the problems which arise in weather forecasting for aviation, which can be classified into three categories, regional, route and local. In forecasting radiation ground fog, the 'Taylor diagram' has not proved very useful in India except that it can be used to rule out days when fog is unlikely. Daily tephigrams based on aeroplane soundings constitute the most valuable items in forecasting convectional phenomena, formation, clearing or persistence of clouds.

The kinematical methods in weather forecasting developed by Dedebant and Pettersen also received attention. Whenever any pressure system, such as a cyclone, an anticyclone, a trough or a front, is in continuous motion, one can, from a knowledge of the changes that have taken place in the system in the previous two or three hours, calculate the velocity and acceleration of each point of the system and thus determine the position as well as the configuration of the system during the next 6 or 12 hours. The deepening or filling of pressure over an area bounded by two closed isobars is equal to the planimetric value of the barometric tendency within the same area. Dr. S. K. Banerji gave an application of these and other kinematical laws to certain Indian storms, particularly to explain the curvature of their tracks.

In winding up the discussion, Dr. Normand referred to the future of weather forecasting. He said that it seems doubtful whether the statistical methods applied to surface data will result in any appreciable improvement of seasonal forecasting. The region where we have to look for the improvement of forecasts of all kinds from short to long range is the upper air. More data by aeroplanes, *radio sondes* and balloon meteorographs are needed both in day-to-day analysis of the weather situation and in the search for factors of use in seasonal forecasting.

Engineering Research and Soil Corrosion

In February 1935, the Council of the Institution of Civil Engineers adopted a more active policy in regard to engineering research and constituted a Research Committee with wide terms of reference. Previously, specific problems had been investigated by committees appointed specially for each case, and their work produced results of great importance. The growth in scientific knowledge and in the size and complexity of the problems confronting the engineer, and also the great changes which have been effected in the materials with which he has to work, brought about a realization of the necessity for greater understanding of the scientific basis of engineering practice. The Committee was entrusted with the duties of making recommendations of subjects for research and investigation, and of maintaining contact with other bodies engaged in similar work. While it has mainly limited its activities to problems in branches of engineering not ordinarily included in the programmes of the more specialized institutions, it has actively co-operated with many of these in researches of common interest.

The report of the Committee for the years 1935–36 and 1936–37 has now been issued[1]. The general policy has been to make use of the existing research organizations such as those of the Department of Scientific and Industrial Research, and of the universities and technical colleges, and no attempt has been made to set up an independent laboratory. The researches in which the Committee is in this way taking part are classified under the general headings: materials, soil mechanics, hydraulics, structures, and specialized engineering practice—and it will be of interest to those engaged in other branches of science to learn of the inclusion of such subjects of investigation as the most desirable types of fish-passes in rivers and the practice to be prescribed for the use of self-contained breathing apparatus in sewers and other engineering works. None of the investigations has as yet been completed but, from time to time, in the *Journal* of the Institution, in the proceedings of other societies and in the technical press, reports of progress or of partial results have been published.

Part 2 of the report gives detailed accounts of the progress of the researches undertaken. One of these deals with "Soil Corrosion of Metals and Cement Products". The increasing occurrence of reports of severe corrosion of concrete in clay soils containing sulphate salts has shown the need for more information than is at present available as to the conditions which are potentially dangerous and as to the most effective protective measures. After a questionnaire had been circulated to engineers throughout Great Britain inquiring into the prevalence of corrosion and the type of soil in which it was found, it became evident that the research ought to be organized on a wider basis, and a new committee was formed to include members from the Iron and Steel Institute, the British Non-Ferrous Metals Research Association, the National Physical Laboratory, the Building Research Station and the Rothamsted Experimental Station. Considerable financial support is being given by manufacturers and organizations interested in cement and concrete, and a scheme of research extending over ten years has been envisaged.

From a study of the work already recorded, it has been made evident that the corrosion of metals is far more dependent upon the nature of the soil, its composition and physical condition in respect of perviousness, moisture-content, etc., than upon any variations in type of ferrous metal or in the state of a non-ferrous metal. A necessary preliminary to the consideration of tests on various metals is therefore the decision to concentrate attention on conditions of environment, for which purpose a special sub-committee has been formed.

A separate research on the subject of "Vibrated Concrete" has yielded several interesting results. From the work so far carried out, it appears that the properties of vibrated concrete are merely those of a concrete in which satisfactory consolidation has been obtained with mixes which are drier than those associated with hand-compacting. The method thus

extends the range of water/cement ratios towards lower limits than were previously practicable, with the results that strength and density can be improved, shrinkage and creep are reduced, and the bond with reinforcing steel is increased.

In 1932, research on the stresses set up during the driving of reinforced concrete piles was commenced at the Building Research Station and was carried on in collaboration with the Federation of Civil Engineering Contractors. It was initiated as a direct result of the difficulties experienced under certain conditions of hard driving, where it was found impossible to comply with the specification and at the same time to avoid serious damage to the pile. This is one of the investigations in which the Civil Engineers' Committee is now co-operating and, as it happens, the report of the research work carried out has also recently been issued[1]. In and around London there are many building sites where the ground consists of alluvial or made-up soil of very low bearing power for a depth of 10–30 ft. Below this is a stratum of hard compact gravel the thickness of which on any one site may vary from a foot or two to so much as 20 feet. Under the gravel, soft earth of low-bearing power is again found and at a still greater depth the hard compact clay is reached. The uncertainty of the gravel stratum as a foundation for important structures has made it advisable to found on the hard clay. It is in the penetration of the gravel that the difficulties referred to have been experienced, and excavation of driven piles has revealed unsuspected damage underground. Uncertainty was, in consequence, felt as to the condition of piles driven on such sites. The current theory assumes uniform stress distribution through the pile; but, as the velocity of stress propagation in a reinforced-concrete pile is approximately 12,000 ft. per second, research was necessary. This involved an examination of the nature and magnitude of the stresses induced in piles by impact, a study of the effect upon impact resistance of the design and methods of manufacture of the pile, and the development of means of indicating dangerous conditions during driving.

In addition to a number of facts of the highest practical importance which have emerged from the research, as to both the conditions which arise and the best methods of driving, a mathematical theory is outlined which is shown to conform to the results of the experimental investigation in all its main conclusions and to be applicable to estimate the stress at any point under known conditions. An expression is given for the Young's modulus of an equivalent homogeneous pile; but, as the mathematical expressions for the stresses are too complicated for practical use, the results have been given in the form of charts showing the maximum compressive stresses at the head and foot for different weights of hammer, stiffnesses of cushion, etc. Further research is suggested, and it is obvious that one of the chief sources of uncertainty and trouble is the unsatisfactory nature of existing methods of cushioning the blow. A head cushion of constant properties and capable of ensuring a uniform distribution of stress over the pile head would not only prevent the majority of head failures but also would enable data to be collected on bearing capacity under controlled head conditions. Of the packings in common use which were tested in the special impact machine, sackcloth has so far exhibited the best characteristics.

[1] The Institution of Civil Engineers. Report of the Research Committee for the years 1935–36 and 1936–37. Published by the Institution, Great George Street, S.W.1.

[2] "An Investigation of the Stresses in Reinforced Concrete Piles during Driving". Building Research Technical Paper No. 20 (Department of Scientific and Industrial Research). (London: H.M. Stationery Office, 1938.) 3s. net.

Training and Research in Electrical Engineering

DR. A. P. M. Fleming, in his inaugural address to the Institution of Electrical Engineers on October 20, discussed the progress made in the methods of selecting the personnel required for the electrical engineering industry and the methods employed to develop scientific discoveries. In former days, ideas were conceived and developed by the individual effort of men of genius; to-day, in the universities and great scientific laboratories, teams of scientific workers are at work, extending the boundaries of knowledge, out of which possible applications in industry may emerge. The great manufacturing organizations find it necessary to be continually increasing their technically trained staff and to engage men of wide scientific attainments so as to apply the knowledge that practical research yields.

Many of the new discoveries affecting our industry arise from the work of the physicist. The field in which the physicist now works has developed in such a manner that, compared with fifteen years ago, he often needs for his researches plant of great engineering magnitude—plant which has to yield hundreds of thousands of kilowatts or many millions of volts. On this account, as well as for other reasons, it is probable that the great manufacturing organizations will undertake more and more fundamental research.

A pleasing feature during the last ten years has been the tendency towards co-operative research whereby problems of common interest to a large number of different organizations are pooled. This avoids overlapping of effort and has enabled the smaller concerns to profit equally with the large ones, for the knowledge thus revealed is available to all on the same common basis as a raw-material supply. A great deal of the responsibility for continued technical development falls on the manufacturer. The manufacturing branch of the electrical industry now employs 70 per cent of all the workers engaged in electrical applications.

There are three principal educational levels of entry into the electrical industry. In the lowest of these are those youths who are recruited at ages between fourteen and sixteen years from the elementary, central, junior technical and junior secondary schools; the intermediate level comprises those of sixteen to eighteen years of age, who have reached matriculation or higher school certificate standard in secondary schools, whilst in the highest level are those who

enter as graduates from the universities and large technical colleges.

The electrical profession is a democratic one, in that no matter what the educational level of the entrant is, he can, if he has the requisite ability and ambition, climb to the highest ranks. The importance of attracting the very best recruits from each level and of encouraging, and affording facilities for, the upward mobility of the individual according to his aptitude and capability, cannot be over-estimated.

The question of the selection of a recruit for a particular post is most important. Dr. Fleming is of the opinion that for most types of industrial employment the best results are obtained when methods of self-selection are employed, and the entrant is given an opportunity after he has had some manufacturing experience under sympathetic guidance, of deciding for himself the branch of works to which he is best suited. An increasing number of youths entering from the lowest educational level secure promotion through following a course of technical study leading to national certificates. There is now an increasing tendency on the part of employers to permit their apprentices to attend equivalent part-time day courses in the local technical institutions.

This democratic tendency is in sharp contrast to the system in operation in Germany where, for the most part, the upper level attainable even by an ambitious youth is dictated by his starting level. This restricting feature must react on the enthusiasm of one forced to resign himself to a predetermined status with little if any prospect of further advancement. The U.S.S.R. plan has certain political limitations, but it endeavours to select, educate and train its entrants to industry, solely on the basis of merit, with a considerable amount of success.

University Events

LEEDS.—Dr. P. L. Sutherland has been elected to the chair of forensic medicine in succession to the late Prof. Maxwell Telling. Prof. Sutherland, a graduate of the University of Glasgow, has held an appointment in the University as lecturer in the pathology of industrial diseases since 1920. He has been since 1910 pathologist to the West Riding County Council, a post which he will continue to hold.

LONDON.—Dr. Harry Jones has been appointed as from October 1 to the University readership in mathematics tenable at the Imperial College—Royal College of Science. During 1933–37 he was lecturer in theoretical physics in the University of Bristol, and since October 1937 he has been attached to the Royal Society Mond Laboratory in Cambridge.

Mr. F. W. Paish has been appointed as from October 1, 1938, to the Sir Ernest Cassel readership in business finance tenable at the London School of Economics. Since 1932 he has been one of the Sir Ernest Cassel lecturers in commerce at the School and also secretary of the London and Cambridge Economic Service.

The following titles have been conferred in respect of posts held at the institutions indicated: professor of Near Eastern archæology on Mr. Sidney Smith (Institute of Archæology); reader in electrical engineering on Dr. H. E. M. Barlow (University College).

Science News a Century Ago

The Ashmolean Society

AT a meeting of the Ashmolean Society, Oxford, on October 29, 1838, Prof. Baden Powell read a paper entitled "On Refractive Indices". The object of this communication was to state the results of a series of observations, in which the author had been engaged during the summer, in extension and verification of his former researches. Besides the general object of more accurate determination of refractive indices for definite rays in several important media, he had in view the settlement of some points on which questions had been raised, and in some preliminary remarks, he adverted especially to certain objections raised by Sir David Brewster at the Newcastle meeting of the British Association. At Newcastle, Powell had read a paper entitled "On Some Points connected with the Theory of Light" while Brewster had read another entitled "On a New Kind of Polarity in Homogeneous Light". In the discussion on these papers there was a marked difference of opinion, and this found expression also in the pages of the *Athenæum* after the reading of Powell's paper to the Ashmolean Society.

The Zoological Society

AT a meeting of the Zoological Society on November 1, 1838, the annual report, which was read, stated that the receipts for the year up to October 31 amounted to £13,230 and the expenditure to £10,997, leaving a balance of £2,232. The council had determined upon an alteration in the mode of introduction to the gardens on Sundays. Each fellow was to have a ticket for his own personal use and two checks for the admission of friends.

Henry's Electrical Researches

ONE of the most important memoirs of Prof. Joseph Henry, of Princeton College, was that "On Electro-dynamic Induction" read to the American Philosophical Society on November 2, 1838, in which he gave the results of his extension of the purely electrical part of "Faraday's Admirable Discovery". In his experiments, Henry had employed "five different sized annular spools of fine wire (about one-fiftieth of an inch thick) varying from one-fifth of a mile to nearly a mile in length (which might be called 'intensity' helices); and six flat spiral coils of copper ribbon varying from three-quarters of an inch to one inch and a half in width, and from 60 to 93 feet in length (which might be called 'quantity' coils)". These he combined in various ways. By the alternations of the ribbon and wire coils, the fact was established "that an intensity current can induce one of quantity, and by the preceding experiments the converse has also been shown that a quantity current can induce one of intensity; a result which has had an important bearing on the subsequent development of the electro-magnetic induction coil" (W. B. Taylor's discourse on the scientific work of Joseph Henry). In his experiments, Henry used various batteries, one being a cylindrical battery of one and three-quarters square feet of zinc surface, another a Cruickshanks battery of 60 elements 4 inches square and another Dr. Hare's battery, 32 one-gallon jars. The investigations were fully dealt with by the French physicist, Antoine C. Becquerel, in vol. 5 of his "Traité expérimental de l'Électricité et du Magnétisme".

Societies and Academies

Paris

Academy of Sciences (*C.R.*, **207**, 509–548, Sept. 26, 1938).

W. DŒBLIN : Sums of a large number of aleatory vectors.

M. GEVREY : Use of Green's quasi-functions for the solution of the problem of Dirichlet relative to the linear equations with regard to the second derivatives only.

G. VAN DER LYN : Abstract polynomials in general vectorial spaces.

S. STOÏLOW : A class of Riemann surfaces *régulièrement exhaustibles* and M. Ahlfors' theorem of disks.

M. SCHIFFER : A theorem of conformal representation.

B. HOSTINSKÝ : A general equation of statistical mechanics.

G. GARCIA : The general problem of exterior ballistics.

J. SOLOMON : Definition of the neutrino. The theory of β disintegration does not necessarily imply the existence of a new particle, the neutrino, but only a certain number of structural properties necessary for conservation of the total system.

G. BECK : Remarks on the characteristic transversal energy of an electron.

MLLE. M. THÉODORESCO : Raman spectrum of molybdic acid in aqueous solution.

M. PRETTRE : Influence of the dimensions of combustion chambers on the speed of oxidation of mixtures of pentane and oxygen.

Y. VOLMAR and E. WEIL : Action of antimony anhydride and of antimony sulphide on thiol acids.

A. WILLEMART : Researches on the dissociable oxides of anthracene : photo-oxides of cyclohexyl-9-anthracene and of phenyl-9-cyclohexyl-10-anthracene.

J. BRICARD : Haloes and anti-haloes in the natural mist at the summit of the Puy de Dôme.

L. BINET and M. STRUMZA : Ephedrines as active agents in the fight against anoxyemia.

S. SABETAY, L. PALFRAY and L. TRABAUD : Presence of benzyl-cyanide in the semi-solid essential oil of 'Karo Karoundé' [a species of jasmin].

P. CHABANAUD : The protractor muscle of the hypopharyngeals in the dissymmetric teleosteans.

G. BLANC and M. BALTAZARD : Vaccination against exanthematic typhus by dried virus of rat typhus from infected fleas.

Amsterdam

Royal Netherlands Academy (*Proc.*, **41**, No. 7, 1938).

J. CLAY, A. v. GEMERT and P. H. CLAY : Decrease of the intensity of cosmic rays in water to a depth of 440 m. measured with counters and ionization chamber.

J. CLAY, J. T. WIERSMA and K. H. J. JONKER : Distribution of the intensity of cosmic radiation for different directions around the vertical.

J. A. SCHOUTEN : The geometrical interpretation of ordinary p-vectors and W-p-vectors and the corresponding densities.

J. A. NINCK BLOK-KITS VAN HEYNINGEN and D. A. WAS : Investigations on thin layers of tin and other metals (5). The corrosion of tin by dilute organic acids (citric, lactic, propionic, and benzoic acids).

R. DORRESTEIN and J. A. SMIT : Determination of the cross-section of metastable helium atoms with the aid of their 'photo-electric' effect.

P. P. BIJLAARD : A theory of plastic stability and its application to thin plates of structural steel.

C. S. MEYER : Contributions to the theory of Whittaker functions (2).

J. BUTER : Hyper-convex aggregates in the plane.

A. J. RUTGERS, E. VERLENDE and M. MOORKENS : Flow potentials and surface conductivity.

H. J. BUNGENBERG DE JONG : Complex systems of biocolloids. (1) Survey and classification according to colloid-chemical and electrochemical points of view. (2) Specific factors of importance to the intensity of the complex relations, their significance in particular with regard to the formation of the tricomplex systems.

ANNIE M. HARTSEMA and IDA LUYTEN : Rapid flowering of the daffodil (*Narcissus pseudo-Narcissus* var. King Alfred).

W. H. ARISZ and J. OUDMAN : Absorption and transport of asparagine in leaves of *Vallisneria*.

D. E. REINDERS : The process of water intake by disks of potato tuber tissue.

P. H. DE BRUYN and J. H. C. RUYTER : The influence of pre-treatment with or without fixation on the Sudan granulation of leucocytes and the character of phenol granulation in general.

G. C. HIRSCH : The pre-substance of the Golgi system.

JEAN K. WESTON : The topographic relations of ganglion cells to the endolymphatic and perilymphatic sense organs of the vertebrate inner ear.

A. G. VAN VEEN : The isolation of the soporific substance from Kawa-Kawa or Wati.

Vienna

Academy of Sciences, June 30.

G. ORTNER and G. PROTIWINSKY : Reaction of fast neutrons with nitrogen nuclei. A nitrogen-filled ionization chamber is irradiated with fast neutrons and the ionization produced by the disintegration nuclei is measured as a function of the number of disintegrations per second. The results show that in the reaction ${}^{14}_{7}\mathrm{N} + {}^{1}_{0}n = {}^{11}_{5}\mathrm{B} + {}^{4}_{2}\mathrm{He} + Q$, the intermediate nucleus is in one of the states 15·98, 16·91, 17·37 or 17·68 million electron volts above the ground state, while the boron nucleus is in the ground-state or 2·25 or 4·25 million electron volts above it.

R. GROSSMANN : Effect of the addition of electronegative gases on the current-potential diagram of ionized nitrogen. From the form of the characteristic, the amount of oxygen, carbon monoxide and carbon dioxide present may be estimated qualitatively and quantitatively.

G. KÜRTI : Coloration of biotite by α-rays.

H. HORNINGER : *Gegenstrahlfläche* of ruled surfaces.

K. GRAFF : Colorimetric measurement of stars down to magnitude 6·5 between Declination −10° and +20°.

J. KISSER and L. W. SEKYRA : (1) Identification of native woods by microscopic examination of their powders. (2) Identification of the more important native woods by means of the microscopic structure of their ash.

F. KÖCK : Decomposition of the cellulose molecule

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, October 31

UNIVERSITY OF LEEDS, at 5.15.—Prof. D. T. A. Townend: "A New Era in Combustion".*

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—H. W. Tilman: "The Mount Everest Expedition of 1938".

Tuesday, November 1

INSTITUTION OF CIVIL ENGINEERS, at 6.—W. J. E. Binnie: Presidential Address.

Wednesday, November 2

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—E. J. Wayland: "The Face of Uganda".

Thursday, November 3

ROYAL COLLEGE OF PHYSICIANS, at 5.—Dr. Lionel Whitby: "The Chemotherapy of Bacterial Infections" (Bradshaw Lecture).

ROYAL SOCIETY OF MEDICINE, at 5.—W. M. Mollison: "Laryngology's Debt to Research" (Semon Lecture).*

Friday, November 4

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Sir Noel Ashbridge: "The Development of Television".

INSTITUTION OF GAS ENGINEERS, November 1–2.—Autumn Research Meeting.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

DESIGNER (Ref. A.163.O.) at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (November 5).

LECTURER IN ENGINEERING in the County Technical College, Wednesbury—The Director of Education, County Education Offices, Stafford (November 10).

LECTURER IN MECHANICAL ENGINEERING in King's College, Newcastle-upon-Tyne—The Registrar (November 12.)

LECTURER IN GEOLOGY in the Fouad I University, Cairo—The Dean, Faculty of Science, Abbassia, Cairo (November 17).

ASSISTANT NATURALIST FOR FISHERY RESEARCH to the Freshwater Biological Association—The Director, Wray Castle, Ambleside, Westmorland (November 19).

ASSISTANT KEEPER IN THE DEPARTMENT OF ENTOMOLOGY, British Museum (Natural History)—The Secretary (December 1).

HEAD OF THE CHEMICAL DIVISION and a CHEMIST at the Rubber Research Institute of Malaya—The Secretary, London Advisory Committee for Rubber Research (Ceylon and Malaya), Imperial Institute, London, S.W.7 (December 18).

INSPECTOR OF MINES in Cyprus—The Director of Recruitment (Colonial Service), 8 Buckingham Gate, London, S.W.1.

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Proceedings of the Royal Society of Edinburgh, Session 1937–1938. Vol. 58, Part 2, No. 14: The Association of Non-homologous Chromosomes in Corixidæ (Hemiptera—Heteroptera). By Dr. H. D. Slack. Pp. 192–212. 2*s*. Vol. 58, Part 2, No. 15: On Rare Defects in Human Populations with Particular Regard to In-breeding and Isolate Effects. By Prof. Gunnar Dahlberg. Pp. 213–232. 1*s*. 9*d*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [1010

Mines Department. Seventeenth Annual Report of the Secretary for Mines for the Year ended 31st December 1937, and the Thirtieth Annual Report of H.M. Chief Inspector of Mines for the same Period, with a Statistical Appendix to both Reports. Pp. xx+250. (London: H.M. Stationery Office.) 4*s*. net. [1010

Transactions of the Royal Society of Edinburgh. Vol. 59, Part 2, No. 16: An Investigation of the Mucorales in the Soil. By Dr. Marie E. Campbell. Pp. 411–436+3 plates. 4*s*. 6*d*. Vol. 59, Part 2, No. 17: The Actinopterygian Fishes from the Lower Carboniferous of Glencartholm, Eskdale, Dumfriesshire. By J. A. Moy-Thomas and M. Bradley Dyne. Pp. 437–480+2 plates. 6*s*. 3*d*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [1010

Transactions of the Royal Society of Edinburgh. Vol. 59, Part 2, No. 18: The Food and Feeding of the Brown Trout (*Salmo trutta* L.) in relation to the Organic Environment. By R. M. Neill. Pp. 481–520. 5*s*. Vol. 59, Part 2, No. 19: The Female Reproductive System and Corpora Lutea of the False Killer Whale, *Pseudorca crassidens* Owen. By L. C. Comrie and Ann B. Adam. Pp. 521–532. 1*s*. 9*d*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [1310

Netherlands and Netherlands Indies Information Bureau. Third Annual Report of the Committee for the year ending 30th April 1938. Pp. 14. (London: Netherlands and Netherlands Information Bureau.) [1410

Iron and Steel Institute. Special Report No. 23: Third Report of the Steel Castings Research Committee; being a Report by a Joint Committee of the Iron and Steel Institute and the British Iron and Steel Federation to the Iron and Steel Industrial Research Council. Pp. vii+294+12 plates. (London: Iron and Steel Institute.) [1710

Other Countries

National Research Council of Canada. New Hydraulic Laboratories and their Work. By R. Ruedy. Pp. ii+111+18 plates. 1 dollar. Twentieth Annual Report of the National Research Council, 1936–1937. Pp. 182. 75 cents. (Ottawa: National Research Council of Canada.) [1010

Standards on Electronics, 1938. Pp. vii+59. 50 cents. Standards on Radio Receivers, 1938. Pp. vi+58. 50 cents. (New York: Institute of Radio Engineers, Inc.) [1210

U.S. Department of Agriculture. Circular No. 485: *Tetrastichus brevistigma* Gahan, a Pupal Parasite of the Elm Leaf Beetle. By P. A. Berry. Pp. 12. 5 cents. Technical Bulletin No. 618: Biological Studies on the Leafhopper *Empoasca fabæ* as a Bean Pest. By Dwight M. DeLong. Pp. 60. 10 cents. Technical Bulletin No. 623: Fumigation of Baled Cotton with Hydrocyanic Acid for the Pink Bollworm. By A. C. Johnson, George G. Becker and Lon A. Hawkins. Pp. 46. 10 cents. (Washington, D.C.: Government Printing Office.) [1310

Zoologica Sinica. Series B: The Vertebrates of China. Vol. 15, Fascicle 1: The Birds of Hopei Province. By Prof. Tsen-Hwang Shaw. Part 1. Pp. xxxiii+528+13 plates. Part 2. Pp. 529–974+plates 14–25. (Peiping: Fan Memorial Institute of Biology.) [1410

Icones Plantarum Sinicarum. Edited by Hsen-Hsu Hu and Woon-Young Chun. Fascicle 5. Pp. iv+50+plates 201–250. (Peiping: Fan Memorial Institute of Biology.) [1410

Carnegie Institution of Washington. Publication No. 490: Leaf Xanthophylls. By Harold H. Strain. Pp. xi+147. 2 dollars. Publication No. 491: Fauna of the Caves of Yucatan. By A. S. Pearse, with the collaboration of Nathan Banks, Joseph C. Bequaert, Joseph C. Chamberlin, Ralph V. Chamberlin, B. G. Chitwood, William J. Clench, Edwin P. Creaser, Norma C. Furtos, Helen T. Gaige, Theodore H. Hubbell, Carl L. Hubbs, Libbie H. Hyman, Wilton Ivie, Remington Kellogg, Harlow B. Mills, J. Percy Moore, C. F. W. Muesebeck *et al.*, Grace E. Pickford, Horace W. Stunkard, George W. Wharton, William Morton Wheeler, Charles Branch Wilson, Frederick A. Wolf. Pp. iii+304+8 plates. 3 dollars. Publication No. 497: Hibernation and Marmot Physiology. By Francis G. Benedict and Robert C. Lee. Pp. x+239. 2 dollars. Publication No. 502: Modern Maya Houses, a Study of their Archæological Significance. By Robert Wauchope. Pp. vii+181+38 plates. 3 dollars. Publication No. 503: Vital Energetics, a Study in Comparative Metabolism. By Francis G. Benedict. Pp. vii+215. 2 dollars. (Washington, D.C.: Carnegie Institution.) [1410

New Zealand: Department of Lands and Survey. Annual Report on Public Domains and National Parks of New Zealand. Pp. 11. (Wellington: Government Printer.) 6*d*. [1710

Canada: Department of Mines and Resources: Mines and Geology Branch, Bureau of Geology and Topography. Geological Survey, Memoir 207: Cranbrook Map-Area, British Columbia. By H. M. A. Rice. (No. 2435.) Pp. v+67. 25 cents. Geological Survey, Memoir 211: Thetford, Disraeli and Eastern Half of Warwick Map-Areas, Quebec. By H. C. Cooke; with Chapters on the Beauceville, St. Francis and Lake Aylmer Series, by T. H. Clark. (No. 2440.) Pp. vi+160. 50 cents. Geological Survey, Memoir 215: Fossil Flora of Sydney Coalfield, Nova Scotia. By W. A. Bell. (No. 2439.) Pp. ii+334. 75 cents. Geological Survey, Memoir 218: Mining Industry of Yukon, 1937. By H. S. Bostock. (No. 2450.) Pp. ii+21. 10 cents. (Ottawa: King's Printer.) [1710

Bernice P. Bishop Museum. Special Publication 29: Canoes of Oceania. Vol. 3: Definition of Terms, General Survey and Conclusions. By A. C. Haddon and James Hornell. Pp. 88. (Honolulu: Bernice P. Bishop Museum.) [1710

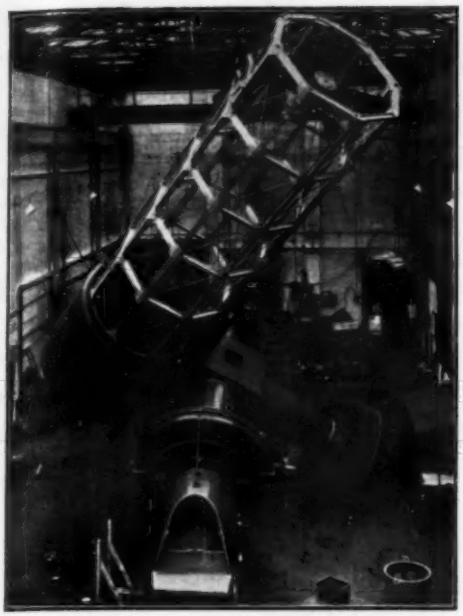
Catalogues, etc.

English Science and Medicine. (List 29.) Pp. 52. (London: E. P. Goldschmidt and Co., Ltd.)

Evertebrata. (No. 95.) Pp. 83. (Den Haag: Antiquariaat Junk.)

The Sea and its Story. (Catalogue No. 630.) Pp. 82. (London: Francis Edwards, Ltd.)

The Wild-Barfield Heat-Treatment Journal. Vol. 3, No. 18, September 1938. Pp. 14–25+vi. (London: Wild-Barfield Electric Furnaces, Ltd.)



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OFFICIAL ANNOUNCEMENTS

UNIVERSITY OF LONDON

A Course of two Lectures on "THE FORMATION OF THE PRONEPHROS AND ITS CAUSES" will be given by PROF. A. DALCQ (Professor of Anatomy in the Université libre de Bruxelles) at KING'S COLLEGE, LONDON (Strand, W.C.2), on NOVEMBER 8 and 10, at 5.30 p.m. At the First Lecture the Chair will be taken by Prof. T. Nicol, M.D., D.Sc. (Professor of Anatomy in the University). Lantern illustrations.

ADMISSION FREE. WITHOUT TICKET.

S. J. WORSLEY,
Academic Registrar.

UNIVERSITY OF LONDON

A Course of Two Lectures on "SOME PROBLEMS OF SUB-SURFACE GEOLOGY IN NORTHERN FRANCE" will be given by PROF. P. PRUVOST, D.ès-Sc. (Professor of Geology and Mineralogy in the University of Lille), at UNIVERSITY COLLEGE, LONDON (Gower Street, W.C.1), on NOVEMBER 8 and 10, at 5.30 p.m. At the First Lecture the Chair will be taken by MR. TREBILIAN C. NICHOLAS, O.B.E., M.C., M.A. (Senior Bursar, Trinity College, Cambridge). Lantern illustration.

ADMISSION FREE, WITHOUT TICKET.

S. J. WORSLEY,
Academic Registrar.

IMPERIAL BUREAU OF ANIMAL NUTRITION

ROWETT RESEARCH INSTITUTE, ABERDEEN

Applications are invited for the post of Deputy Director of the Imperial Bureau of Animal Nutrition, which is centred at the Rowett Research Institute, Bucksburn, Aberdeen, Scotland.

The work of the Bureau consists mainly in the collection and collation of scientific information on nutrition (human and animal) and its dissemination to research workers in countries of the British Commonwealth and abroad.

Applicants should possess an honours degree in Science or a degree in Human or Veterinary Medicine. They should have experience in research on nutrition. A knowledge of foreign languages is desirable and overseas experience will be an advantage.

The salary scale is £400×£20×£600×£25×£800.

The initial salary within the scale will depend on the qualifications and experience of the person appointed. For a properly qualified applicant early promotion to the £600 level is probable.

The person appointed will be included in the Federated Superannuation Scheme for Universities after one year's probation.

Applicants should state age, experience, and qualifications and give at least two testimonials or references.

Applications should be addressed on or before November 19 to:

Sir David Chadwick,
Secretary.
Imperial Agricultural Bureaux,
2 Queen Anne's Gate Buildings,
London, S.W.1.

GOVERNMENT OF INDIA

Applications are invited for the appointment of Research Officer for investigation of contagious abortion in cattle, goats, and sheep, at the Imperial Veterinary Research Institute, Muktesar, India.

Candidates must be natural-born British subjects or subjects of an Indian State who have secured the necessary declaration under Section 262(1) of the Government of India Act, 1935. Age preferably not more than 40 years. They must be M.R.C.V.S., have done at least five years post-graduate work in bacteriology, and possess field experience of the conditions under study.

Appointment subject to probationary period of one year on agreement for three years in first instance. Prospect of appointment being continued for further period of two years. Pay (monthly), Rupees 1,000, rising by annual increments of Rs.50 to Rs.1,200 plus, for a candidate of non-Asiatic domicile, sterling overseas pay of £15, £25, or £30 a month, according to age. Pay at a rate higher than the minimum might be granted in special circumstances. Free 1st-class passage.

Further particulars and forms of application may be obtained, on application by post card, from the High Commissioner for India, General Department, India House, Aldwych, London, W.C.2. Last date for the receipt of applications November 10, 1938.

IMPERIAL BUREAU OF ANIMAL BREEDING AND GENETICS, EDINBURGH

APPOINTMENT OF DEPUTY DIRECTOR

Applications are invited. Salary scale £400—£20—£600 with F.S.S.U. after one year's probation. Initial salary dependent on qualifications and experience.

Qualifications required: Degree in biology, agriculture, or veterinary science. Actual experience with farm animals and/or knowledge of live stock improvement in the British Commonwealth very desirable. Knowledge of foreign languages an advantage.

Applications stating qualifications in detail, mentioning any contributions to scientific literature, and giving at least two references, should reach Prof. F. A. E. Crew, Institute of Animal Genetics, West Mains Road, Edinburgh, before December 1.

The work of the Bureau consists in the collection and collation of scientific information on animal breeding and genetics, and its dissemination to research workers in all countries of the British Commonwealth.

AIR MINISTRY

DIRECTORATES OF SCIENTIFIC RESEARCH AND TECHNICAL DEVELOPMENT

ASSISTANTS GRADE I and II required at the Royal Aircraft Establishment, South Farnborough, Hants.

Ref. 129 O. TWO ASSISTANTS GRADE I, to assist in the design, development and application of aircraft equipment, including the supervision of laboratory trials, and the observation of tests of apparatus during flights. Candidates should have had training in engineering to B.Sc. Degree standard, and considerable workshops and drawing office experience. Experience of armament work would be advantageous, but is not essential.

Candidates should be physically fit for flying and willing to fly as observers.

Ref. 168 O. ONE ASSISTANT GRADE II, to assist in research work in the Aerodynamics Department. Candidates should have had training to the standard of B.Sc. Degree in Engineering. Some workshop and drawing office experience is desirable, and experience of research work connected with aircraft design would be an advantage.

Salary scale: Assistant Grade I. £400 by £10 to £515 a year (men), £325 by £12 to £349 by £10 to £415 a year (women).
Assistant Grade II. £315 by £12 to £385 a year (men), £265 by £12 to £313 a year (women).

Promotion from Assistant Grade II to Assistant Grade I is governed by merit as and when vacancies arise. The appointments will be non-pensionable, but entrants will be eligible for consideration for appointment to pensionable posts in the event of vacancies arising on the permanent establishment.

Application should be made on a form to be obtained (quoting the appropriate reference number) from the Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants, to whom it should be returned not later than November 12, 1938.

AIR MINISTRY

DIRECTORATE OF TECHNICAL DEVELOPMENT

DESIGNER (Ref. A.163 O.) required at the Royal Aircraft Establishment, South Farnborough, Hants. Candidates should have had good technical education and possess extensive engineering knowledge and experience, covering workshops and drawing office. The ability to supervise work and staff is essential. A knowledge of aircraft armament is desirable, but is not essential.

Salary scale: £300 by annual increments for approved service of £10 to £500 a year.

ALSO:

THREE ASSISTANTS GRADE II (Ref. A.164 O.) at the Royal Aircraft Establishment or at Contracting Firms' works. Candidates should have technical training to the standard of a University Degree in Engineering, together with drawing office and workshops experience. Armament experience is desirable but not essential.

Salary scale: £315 by annual increments for approved service of £12 to £385 a year. (Women, £265 by £12 to £313.)

Promotion to higher posts is governed by merit as and when vacancies arise. The appointments will be non-pensionable, but entrants will be eligible for consideration for appointment to pensionable posts in the event of vacancies arising on the permanent establishment.

Application should be made on a form to be obtained (quoting the appropriate reference number) from the Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants., to whom it should be returned not later than November 5, 1938.

AIR MINISTRY

METEOROLOGICAL OFFICE

Assistants, Grade III (male), required in the Meteorological Office. Candidates must be between 17 and 20 years of age. Candidates must have reached their 17th birthday but not their 20th birthday on November 5, 1938. Candidates must have passed the Intermediate Science Degree Examination, or reached an equivalent educational standard. (Note: The Leaving Certificate of the Scottish Education Department will be accepted as an equivalent, subject to certain conditions.)

Salary scale: £130-£12-£214-£12-£310 a year. A deduction of £10 is made for each year or part of year below age of 19.

Assistants III are eligible in due course to be considered for promotion to Assistant II (£315-£385 a year) and Assistant I (£400-£515 a year). The appointments will be non-pensionable, but entrants will be eligible for consideration for appointments to pensionable posts in the event of vacancies arising on the permanent establishment.

Candidates should apply on a form to be obtained from the Under-Secretary of State (S.2.A), Air Ministry, Adastral House, Kingsway, W.C.2. Candidates who have obtained the Leaving Certificate of the Scottish Education Department should indicate the subjects taken and whether on the higher or lower grade.

The closing date for the return of completed application forms is November 5, 1938.

BRITISH MUSEUM (NATURAL HISTORY)

VACANT ASSISTANT KEEPERSHIP

The Trustees of the British Museum invite applications for an Assistant Keepership in the Department of Entomology. Candidates, who must be of British parentage and between the ages of 22 and 28 on April 1, 1939, must have obtained at least second-class honours in the appropriate subject at a university or equivalent qualifications. They should in the first instance write, stating their place and date of birth, educational antecedents and special qualifications, to the Secretary, British Museum (Natural History), London, S.W.7, from whom further particulars may be obtained. Applications must be received not later than December 1.

October 21, 1938.